Prepared by: The Human Environments Analysis Laboratory

HEAL
HUMAN ENVIRONMENTS ANALYSIS LABORATORY

LAWSON
FOUNDATION

Contributors

This report was prepared by the Human Environments Analysis Laboratory (HEAL) of Western University on behalf of The Lawson Foundation.

Lead Investigator

Dr. Jason Gilliland, Professor, Geography, Health Sciences, Paediatrics, Western University; Director, HEAL, Western University

Senior Staff

Dr. Danielle Tobin, Project Manager, HEAL, Western University
Dr. Andrew F. Clark, Project Coordinator, HEAL, Western University
Ania Barszczuk, MLIS, Research Associate, HEAL, Western University

Expert Advisory Panel

Dr. William Avison, Emeritus Professor, Sociology, Paediatrics, Epidemiology & Biostatistics, Western University
Dr. Elizabeth Hayden, Associate Professor, Psychology, Western University
Dr. Leia Minaker, Scientist, Propel Centre for Population Health Impact, University of Waterloo
Dr. Trish Tucker, Assistant Professor, Occupational Therapy, Western University

Graduate Research Assistants

Brenton Button, MSc, PhD student
Catherine DuBreck, BA, MA student
Kate Schieman, BSc, MSc student
Suzanne Tillmann, BSc, MA student
Katherine Wilson, BA, MA student

Undergraduate Research Assistants

Irfaan Cader, Hazel Dhaliwal, Kelly Leighton, Braunwynn Powell, Gajanee Sivapatham, and Johannes Teselink.

Consulting Librarians

Courtney Waugh, MLIS, Research & Instructional Librarian, Weldon Library
Meagan Stanley, MLIS, Research & Instructional Librarian, Allyn & Betty Taylor Library
Roxanne Isard, MLIS, Research & Instructional Librarian, Allyn & Betty Taylor Library

Table of Contents

Contributors 2
Executive Summary 4
Introduction 7
Methodology 9
1. Physical Health and Development 11
1.1 Introduction 11
1.2 Summary by Outcome 11
Park Features 15
1.3 Conclusion 18
1.4 Recommendations 18
2. Mental Health and Emotional Well-Being 20
2.1 Introduction 20
2.2 Summary of Outcomes 20
2.3 Conclusion 25
2.4 Recommendations 26
3. Social and Cognitive Development 28
3.1 Introduction 28
3.2 Summary of Outcomes 28
3.3 Conclusion 33
3.4 Recommendations 33
Conclusion 36
Appendix A: Search Terms 38
Appendix B: Flow Diagrams (PRISMA Format) 39
Appendix C: Summary of Findings related to Physical Health and Development 41
Appendix D: Summary of Findings related to Mental Health and Emotional Well-Being 66
Appendix E: Summary of Findings related to Social and Cognitive Development 75
Appendix F – Year of publications included in review 84
References 85

Executive Summary

It is widely believed that connecting children with nature can, to some degree, improve aspects of their physical health, mental well-being, and cognitive and social development; however, evidence to support this contention is extremely diverse, dispersed, and difficult to interpret. The **primary purpose** of this report was to systematically identify, evaluate, and summarize existing empirical evidence from peer-reviewed studies on the impact of exposure to nature on the health and development of children (aged 0-18 years), and based on the evidence, highlight potential gaps and opportunities for action.

The evidence included in this report was generated from a systematic search of ten bibliographic databases. From these searches, a total of 564,289 titles of articles were identified and screened for relevancy, 5,362 article abstracts were screened further, and 997 full-text articles were read and assessed for eligibility, leading to a final set of 218 articles that were included in the review. Due to vast disparities in the research foci, designs, and methodologies used in the published studies to date, it is difficult to make strong overall conclusions about the benefits of nature for children and youth. Nevertheless, given the rising rates of various physical and mental health issues among Canadian children, and the recognition that children and youth are spending less time outdoors than ever before, the timing is critical for a rigorous systematic review of the empirical evidence on the benefits of nature exposure. This systematic review of peer-reviewed studies published between 1990 and 2016 aimed to answer three key research questions:

*1) How does children's connection with nature benefit their **physical health and development**?*

Findings: The most common benefit/health outcome identified covered among the 154 studies reviewed under this theme was physical activity. More specifically, the research suggests that access to nature can positively influence children's physical activity levels. Various measures/features of nature influence children's physical health, such as living near parks and green space, specific park amenities that are appealing to children and push them to be more physically active, as well as features of neighbourhood environments, such as the density of street trees. A less frequently examined aspect of physical health identified in the review was nature's impact on children's body mass index (BMI) or obesity. Generally, studies demonstrated nature's positive impact in helping children lower their BMI and risk of obesity. It was also identified that nature can play a role in increasing children's fruit and vegetable consumption, when children have direct contact with gardens.

Recommendations: Based on the research evidence, several recommendations can be made to increase knowledge and understanding which can lead to increased access

to nature. Living in neighbourhoods with greenery and near parks and other public green space increases children's physical activity levels. Furthermore, research indicates certain park features which either promote or hinder physical activity, and city planners should (re)design public parks with consideration of those features.

*2) How does children's connection with nature benefit their **mental health and emotional well-being**?*

Findings: The majority of the 31 studies reviewed in relation to this second question was focused on nature's connection to children with ADD/ADHD. A substantial amount of research has been published in this area which collectively indicates that exposure to green settings, open grass, and proximity to green space are all factors that effectively result in milder ADD/ADHD symptoms. Mental health, emotional well-being, resilience, self-esteem, stress, behavioural disorders, and health related quality of life are additional outcomes that were assessed within the peer-reviewed papers included in this review. In general, proximity to green space or parks was positively associated with better mental health and well-being among children and youth, however there is controversy surrounding the effects that green residential surroundings has on mental health and well-being.

Recommendations: In specifically looking at mental health and emotional well-being, future research should include more objective measures of mental health. Furthermore, more research attention needs to be directed toward understanding how nature impacts the mental health and emotional wellbeing of vulnerable or marginalized populations of children and youth. Despite the fact that 31 articles were deemed eligible for the review, there is a general lack of research on children's depression and anxiety in relation to nature. These two disorders, especially in adolescent populations, are key outcomes that have the potential to be mitigated by nature exposure.

*3) How does children's connection with nature benefit their **social and cognitive development**?*

Findings: Among the 33 papers reviewed in relation to the third theme focussing on how nature exposure benefits social and cognitive development, the two most common outcomes under examination were behaviour and academic achievement/performance. The evidence indicates that the natural environment surrounding schools can play a pivotal role in helping children succeed in academics, either through direct contact (i.e., being outside in nature) or indirect (i.e., views of nature from their classrooms). In terms of behaviour, proximity and access to nature, more specifically gardens, parks, and green space, was found to result in adolescents having fewer behavioural and conduct problems. Other studies in this theme examined how children's contact with nature and exposure impacted memory, self-discipline, relationships, focus, and attention.

Recommendations: Outdoor education can provide various benefits to children's social and cognitive development. Integrating outdoor classrooms or outdoor lessons into the curriculum can be a positive complement to traditional classroom learning. Future research should include more in depth examinations of the influence of nature in the home environment, which has not been as thoroughly researched as the school environment.

Overarching themes and recommendations can be made for all three general areas of interest in this review. More research incorporating experimental and longitudinal study designs is critical in order to establish findings that can see substantial change over time and are generalizable. Standardized measures of nature are needed, as questions still remain around what types of nature (e.g., street trees, vegetable gardens, or forest schools) and types of exposure are most beneficial (e.g., direct or indirect?), how much nature is needed to have an impact (i.e., what 'dose'?), and who benefits the most from nature exposure (i.e., which subgroups of children?). The questions of where and when nature exposure has the most beneficial impact on children are also important to pursue further; such questions may best be answered using a mixed-methods approach combining direct observations of children's environmental behaviours and outcomes. From an intervention standpoint, there is a substantial opportunity to incorporate nature exposure into children's everyday learning and play time through school curricula. Urban planners, landscape architects and land developers play a key role in developing opportunities for nature engagement in neighbourhoods that will facilitate positive development in children, and therefore these actors should be integrated in the research process to ensure practical translation of findings. Finally, policy makers have the potential to influence how parents and children understand the impact nature has on their development. Emphasizing this impact through programs and education may be the most efficient way to demonstrate to the public the importance of being outdoors. The results of this review will help the Lawson Foundation and other key knowledge users to develop more effective programs, policies, practices, and other interventions involving connecting children with nature to improve their overall health and well-being.

Introduction

There is a growing body of literature which suggests that exposure to natural environments and direct contact with nature brings many benefits for health and well-being; however, most of the research to date has focussed on adults, rather than children (Maller, 2009). It is commonly believed that connecting children with nature can, to some degree, bring benefits for their physical health, mental well-being, and cognitive and social development; yet the evidence to support this contention is extremely diverse, dispersed, and difficult to interpret. Studies have shown that exposure to nature has the potential to improve psychological and physiological aspects of health and well-being for children, including increased physical activity levels, better cognitive and emotional functioning, enhanced creativity and intellectual development (Kellert, 2002; Maller, 2009; Maller & Townsend, 2006; Wells, 2000). Given the increasing rates of obesity and mental health issues among children in recent decades (Tremblay and Willms, 2000), there is an urgent need to more critically examine the potential benefits of nature engagement as an approach for combatting these aforementioned challenges to children's well-being. It has been argued that the relationship that children develop with nature begins at an early age through physical exposure, is long-lasting throughout adulthood, and is important to continuous healthy emotional, cognitive, and intellectual development (Kellert, 2002; Müderrisoglu & Gultekin, 2015). Despite the potential cognitive, social, and health benefits, there has been a marked decline in children's overall exposure to nature over the last 20 years (Burdette & Whitaker, 2005; Kellert, 2005; Taylor & Kuo, 2006).

Given the benefits that nature contact and exposure can have on children, it is important to further explore the evidence on this association, in order to guide evidence-informed decision making. The present report aimed to address the overarching question: ***What are the benefits of children's engagement with nature?*** To address this overarching question, we were guided by three specific research questions, as follows:

1. How does children's connection with nature benefit their **physical health and development**?

2. How does children's connection with nature benefit their **mental health and emotional well-being**?

3. How does children's connection with nature benefit their **social and cognitive development**?

In relation to Question #1, numerous claims have been made about the impact of nature on ***physical health and development***. For example, several studies have found higher physical activity levels and lower BMI among children living in areas with more parks (Gilliland et al, 2012; Tucker et al., 2009). Furthermore, more street trees along the

route significantly increases the likelihood a child will walk to school (Larsen et al., 2012).

In relation to Question #2, it has been suggested that spending time in nature provides improvements in children's ***mental health and emotional well-being***. For example, one influential study showed how children who are highly stressed found comfort and decreased stress levels when they were exposed to more green spaces (Wells & Evans, 2003). Emotional and behavioural benefits, such as self-confidence, self-esteem, self-awareness, autonomy, and initiative, are all found to increase with frequent exposure to natural environments (Kochanowski & Carr, 2014; Gill, 2011).

In relation to Question #3, research suggests that being exposed to nature may also offer ***social and cognitive development benefits*** for children, such as enhanced scientific learning, communication skills, and development of positive relationships. Wells (2000) discovered that daily exposure to nature can heighten children's cognitive ability by increasing their ability to focus. Nature exposure for children can also provide various learning and educational benefits. For example, Blair (2009) found that school gardening projects had a positive impact on children's achievement and behaviour.

To answer each research question (#1, #2 and #3), three separate systematic reviews were conducted, each with their own search terms specific to the outcomes in question. In this report, each systematic review will have its own section detailing the overall findings from the eligible studies, with the recurring themes found in the literature. Furthermore, each review has a recommendations section targeting researchers, practitioners, policy makers, and planners to provide potential directions to further explore how nature impacts children and what avenues should be pursued to ensure this relationship is strengthened. A detailed description on our search process and our search terms is also provided in the methodology section of this report.

Methodology

Scoping Review

Following the guidelines for systematic reviews outlined in Petticrew and Roberts (2006), the first step in our review process involved conducting a scoping review. A scoping review involves a preliminary search, before a systematic review, to scope existing literature and assess the types of studies that have been conducted on the topic under study (Petticrew & Roberts, 2006). The scoping review, including an examination of previous systematic reviews, provided critical information in assisting with the creation of the search terms that would encompass all of the relevant literature.

Following the scoping review, a set of search terms for the full review was developed by the lead investigator and senior staff, which were in turn reviewed by our expert advisory panel and supplemented with additional search terms based on panel members' vast knowledge of the subject areas. Furthermore, our search process was reviewed by three research and instructional librarians from Western University. The search terms included a common set on nature search terms (e.g., green space, park) and participant search terms (e.g., child, youth) used in each review, and then each of the three reviews (i.e., physical health and development; mental health and emotional well-being; and social and cognitive development) included their own separate outcome search terms that were appropriate for reviewing literature on the specific subject area. A diverse and exhaustive list of terms was generated to ensure that the search was comprehensive and included all relevant literature. The final list of search terms is included in Appendix 1.

To assist with data selection, inclusion and exclusion criteria were established by the expert panel. It was decided that the review should include only peer-reviewed journal articles published between the years 1990 and 2016, as this time frame represents approximately one generation. In addition, articles had to be written in English or French (Canada's two official languages), and the study participants had to be children 18 years of age or younger. In Canada, the age of majority is 18 years of age in six provinces (Alberta, Saskatchewan, Manitoba, Ontario, Quebec and Prince Edward Island), and 19 years of age in the remaining four provinces (British Columbia, New Brunswick, and Nova Scotia) and the three territories (Northwest Territories, Yukon, and Nunavut). Throughout this report, we use the term child to refer to any person 18 years old or younger. Because individuals may achieve various benefits via exposure to nature, not simply direct contact with nature, outdoor and indoor environments (e.g., a classroom, home) were included, as long as there was a direct contact with nature or views from windows. Furthermore, studies using only photos, videos, or computer images to represent nature were excluded from the review. Finally, only quantitative studies were included in this review; although, qualitative research can provide

important information and context, it is more difficult to assess and compare potential outcomes of nature exposure among results of qualitative studies.

Search Strategy

Ten databases were searched: PubMed, Scopus, PsycINFO, Geobase, ProQuest Nursing and Allied Health, SPORTDiscus, Sociological Abstracts, Leisure and Tourism Database, Physical Education Index, and EMBASE. These ten databases were identified as being relevant to the subject matter and the inclusion of such a large number of databases ensured a comprehensive search strategy which captured as much pertinent literature as possible. Each database was searched separately for the three systematic review topics.

Using the finalized search strings and criteria, relevant articles were identified in the final set of approved electronic databases. Given the large number of articles that each search generated (e.g., sometimes upwards of 20,000), a preliminary scan was conducted based on the article title. If the title was deemed relevant, the article was exported into our own respective database set up in Mendeley reference manager software for further analysis. Following this step, articles were then identified as either relevant or not, according to our research questions and inclusion/exclusion criteria, by reviewing and screening the titles and abstracts. Each article was screened by one graduate student research assistant and one senior staff, and any discrepancies were settled by another senior staff. All articles that failed to meet the inclusion criteria were removed from our three databases, in addition to any duplicates.

Following abstract screening, the remaining articles were further reviewed for eligibility by senior staff, who then extracted all relevant information from each article into data extraction tables. Eligibility of each article was reviewed by two reviewers to ensure consistency. Finally, the bibliography/reference lists of the included articles were examined for any additional articles that may have been missed in the original search. If an article was found, it was downloaded and the screening and eligibility process was repeated to determine if it was appropriate to add to our final list.

1. Physical Health and Development

1.1 Introduction

The first section of this review examines the literature connecting nature and children's physical health and development. Although physical health can encompass numerous different outcomes, the main outcomes identified in the literature that met eligibility criteria for this review were food consumption, Body Mass Index (BMI), obesity, and physical activity. As demonstrated in the summary table, physical activity represented the most common outcome variable examined in the literature. Within the studies identified, a number of independent variables were identified to represent nature, the most common being: parks, gardens, school yards, trees, vegetation, beaches, and home environment.

1.2 Summary by Outcome

Table 1.1: Number of Studies with Physical Health and Development Outcomes

Outcome/Benefit	Number of Studies
Food Consumption	**10**
BMI and Obesity	**28**
Motor Development and Skills	**1**
Health	**4**
Physical Activity	**112**

Food Consumption

An important component of children's physical health entails eating habits, particularly food consumption. Poor dietary patterns are sizeable and widespread in adolescents and have been clearly associated with increasing obesity rates. The presence and use of gardens increases access to and consumption of fruits and vegetables in young children (Meinen, Friese, Wright, & Carrel, 2012). The studies that reported on food consumption, examined this outcome through contact with gardens, either school based or community gardens.

The majority of studies found that a school garden positively affected food consumption habits and that in-school gardens can be used to enhance children's eating habits (Hermann et al., 2006). Multiple studies found that gardens in schools increased access to and consumption of fruits and vegetables in children (Hermann et al., 2006; Meinen et al., 2012; Parmer, Salisbury-Glennon, Shannon & Struempler, 2009). School gardens can also, significantly increase children's willingness to try new fruit, choose fruit or vegetables as a snack over chips or candy, and taste new vegetables that were grown in these gardens (Meinen et al., 2012). Children who take part in the gardening process are more likely to consume more vegetables and find them tastier as well (Parmer et al., 2009; Morgan et al., 2010). Cosco, Moore, and Smith (2014) found that the installation of gardens in a child-care setting offered children hands-on opportunities to taste new fruits and vegetables. However, one study did not find similar results, stating that there was no significant relationship between school gardens and increased fruit and vegetable intake (Utter, Denny, & Dyson (2015). The conflicting results could be due to age differences of subjects, given that this particular study was with high school aged adolescents, while the other studies examined children 12 years and under.

A community garden can be defined as a "piece of land gardened collectively by a group of people" (Castro, Samuels, & Harman, 2013, p. S194). Seven studies examined the influence that community gardens have on children's fruit and vegetable consumption. The exposure, availability, and accessibility to fruits and vegetables from community gardens were associated with increases in consumption (Spears-Lanoix et al., 2015; Morgan et al., 2010). One particular study found that a garden program positively impacted fruit and vegetable consumption in youth, particularly in boys (Lautenschlager & Smith (2007). The overarching message from these studies demonstrates the impact that either a school or community garden can have on children's physical health by increasing their consumption of fruits and vegetables (Castro et al., 2013).

BMI and Obesity

A second outcome identified in this sub-theme was BMI and/or obesity. Time spent outdoors, proximity to parks and playgrounds, neighbourhood greenness, vegetation growth, tree densities, walkable environments, school environmental programs, and community interventions are all elements of nature that have been shown to have an impact on BMI and rates of obesity in children.

Numerous studies identified that children with access to parks and outdoor facilities have a decreased risk of being overweight and obese as measured by BMI (Alexander, Huber, Piper, & Tanner, 2012; Fan & Jin, 2013; Wasserman, Suminski, Mayfield, Glaros, & Magie, 2014; Wolch et al., 2011). Potwarka, Kaczynski, and Flack (2008)

contest this finding and state that availability of park space does play an important role in children's weight status, but certain park facilities may play a more crucial role.

In one study, Melius (2013) revealed that children, on average, are 18% less likely to be overweight or obese when living within walking distance to a park or playground in their neighbourhood. Five additional studies demonstrated that children living near parks, playgrounds, and recreational facilities had lower odds of overweight and obesity, and lower BMI scores (Potestio et al., 2009; Veugelers, Sithole, Zhang, & Muhajarine, 2008; Fan & Jin, 2013; Armstrong, Lim, & Janicke, 2015). In addition, five studies reviewed showed that residential greenness, residential proximity to forests, tree patches, urban forests, and street tree densities were associated with lower BMI and prevalence of obesity (Lovasi et al., 2013; Dadvand et al., 2014; Kim, Lee, Olvara, & Ellis, 2014; Bell et al., 2008, Saunders et al., 2015). Neighbourhoods with lower availability of these amenities show 20- 45% higher odds of obesity rates (Singh, Siahpush, & Kogan, 2010); however, two studies found no direct relationship between nature and rates of obesity and childhood adiposity (Casey et al., 2012; Hrudey, Kunst, Stronks, & Vrijkotte, 2015).

School programs, such as nutrition and gardening interventions, showed beneficial results lowering BMI and preventing childhood obesity. Three studies showed the positive impact of school gardens on children's weight and prevalence of obesity (Slaney, Salmon, & Weinstein, 2012; Spears-Lanoix, et al., 2015; Utter, Denny, & Dyson, 2016).

Motor Development and Skills

A study conducted with children 5 to 7 years old determined that children who used a forest as their playground performed better on motor fitness tests, in terms of their motor skills, compared to children who used a traditional playground (Fjortoft, 2001).

Health

Four studies examined the influence of nature on physical aspects of health including overall general health, asthma, nasal congestions, and sleep. Having larger and more trees in the home neighbourhood was associated with higher health related quality of life (Kim, Lee,& Sohn, 2016) and the probability of being healthy (Kytta et al., 2012). Furthermore, one study found that more street trees was associated with lower prevalence of asthma in children (Lovasi, Quinn, Neckerman, Perzanowki, & Rundle, 2008). Being outdoors was also found to be negatively correlated with health problems such as asthma, nasal congestions, and difficulty sleeping (Hammond, et al., 2011).

Physical Activity

Within the review of physical health and development, the majority of studies identified focused on physical activity as an outcome. This was not surprising given the low rates of children's physical activity levels in Canada, as well as around the world. The articles pertaining to physical activity examined the behaviour in numerous ways, using a variety of measures and definitions. Some studies touched upon intensity of physical activity (light, moderate, moderate-to-vigorous, or vigorous), while others focused on the duration of physical activity (minutes per day, amount per day or week). Furthermore, physical activity was measured using different means: observations, self-reported measures (either by parents or children themselves), pedometers (step count), and accelerometers. Given the sheer number of studies (N=112) and the level of variability found within the outcome of physical activity, the findings from those studies will be presented differently than other findings. Within the outcome of physical activity, the overall findings will be broken down by the following nature components: parks, proximity to parks features, park, schoolyards, school gardens, neighbourhood environment, and tree density. The table below presents the number of articles per section. All of these variables of nature were found to impact children's physical activity levels. Therefore, the findings for physical activity are presented below based on their nature variable, to allow for grouping of common findings together.

Table 1.2: Number of Studies on Physical Activity by Type of Nature Exposure

Nature Exposure	Number of Studies
Parks	**75**
Green Space	**18**
Neighbourhood Environment	**19**
School Environment	**19**
Gardens	**20**

Overall Physical Activity

When children participate in physical activity outdoors it is not always in greenspace. However, a study identified that when boys spend time outdoors their physical activity levels are significantly higher when they are in greenspace (Wheeler, Cooper, Page, & Jago, 2010). Wheeler et al. (2010) also noted that when children, particularly boys, are physically active outdoors in greenspace it is at a higher intensity compared to other activities in non-greenspace.

Parks

A common theme that emerged throughout this review is the influence parks can have on children's physical activity levels. A total of 75 included studies discussed the various ways in which parks play an important role in promoting children's physical activity. Generally, studies revealed a positive association between increased accessibility to parks and enhanced physical health and development. Children, particularly teens, were most often observed engaging in vigorous activities in the park (Reed, Price, Grost, & Mantinan, 2012). Parks and green spaces provide children with favourable avenues for physical activity (Besenyi, Kaczynski, Stanis, 2013; Cohen, Marsh, &Williamson, 2014; Larson, Whiting, Green, & Bowker, 2015). Within the topic of parks, two sub themes emerged: park features and proximity to parks.

Park Features

The levels of physical activity observed in children can be greatly influenced by the features found within a park. Certain features, or amenities, commonly found in parks can determine levels of activity in children; therefore, it's important to understand the specific park features that help increase physical activity levels in parks (Reis, Hino, Florindo, Anez, & Domingues, 2009). One study mentioned that paved trails led to more intense physical activity whereas areas covered in dirt, mud, or wood chips resulted in less intense physical activity levels (Baek, Raja, Park, Epstein, Yin, & Roemmich, 2015).

Green areas, as well as parks with a high number of trees, were found to encourage a higher percentage of children engaging in moderate physical activity (Dyment, Bell & Lucas, 2009; Edwards, et al., 2015). Those parks which offer lighting around sports courts and equipment were also identified as particularly encouraging of physical activity (Edwards, et al., 2015). In addition to the specific features afforded, parks which offered a number of amenities, were associated with more time engaged in physical activity and participation in higher intensity activity (Coughenour, Coker, & Bungum, 20014)

One particular study found that the removal of benches within a park was associated with increased activity intensity in children (Roemmich, Beeler, & Johnson, 2014). However, it must be noted that the level of activity observed in parents while in the park positively influences that of the child. Therefore, if parents have less access to benches or seating area they tend to be more physically active with their children (the observed level of parental activity increased when there are fewer places to sit; Roemmich, Beeler, & Johnson, 2014). The majority of studies identified that boys were more physically active at parks compared to girls. However, Baek et al., (2005) found that girls were very active in park settings. This further supports the need for future research examining sex-based differences.

Results from these studies highlight, not only the type of physical activity children engage in, but ways to increase their physical activity levels. Within parks, physical activity breeds more physical activity amongst children (Bocarro, Floyd, Smith, 2015). Therefore, creating spaces where children can freely engage in physical activity can only positively influence their physical health and development. The development of unused space into a recreational park has proven to significantly increase observed levels of energy expended within the park boundaries in children (King, Litt, Hale, Burniece, & Ross, 2015). This demonstrates that features in a park can influence adolescent's levels of physical activity.

Proximity to Parks

As previously mentioned, another common theme from the research was how proximity to parks can be beneficial for increasing physical activity levels in children. Several studies indicated that living closer to a park was associated with higher levels of physical activity in children and adolescents (Paudel, Subedi, Bhandari, Bastola, Niroula, & Poudyal, 2014; Epstein, Raja, Gold, Paluch, Pak, & Roemmich, 2006; Edwards et al., 2015). Living near parks and beaches increases the opportunities for children and adolescents to engage in physical activity (Grow, Saelens, Kerr, Durant, Norman, & Sallis, 2008; Edwards, Giles-Corti, Larson, & Beesley, 2014), especially if the park has a high vegetation density (Dunton, Almanza, Jerrett, Wolch, & Pentz, 2014). Furthermore, being able to walk or bike to the park will increase the likelihood of children and adolescents using them, which in turn can increase physical activity (Grow, et al., 2008). Living near a park also allows children to use active modes of transportation to get to and from the parks (Perry, Saelens, & Thompson, 2011), again reinforcing physical movement. These studies demonstrate the positive benefits of having a park near a child's home; however, if the parks are deemed unsafe, by children or their parents, the likelihood of children using them as a place to be physically active decreases (Echeverria, Luan, Isasi, Johnson-Dias, & Pacquiao, 2014; Babey et al., 2008; Babey, Tan, Wolstein, & Diamant, 2015).

The information presented in both the features of park and proximity to park themes, illustrates how influential parks can be in promoting children's physical activity levels. Although some of the findings are contradicting, it is important to note that certain park features play a key role in helping kids be active. In addition, living close to parks provides a great opportunity for children to engage in physical activity.

Neighbourhood

The environment around one's home can provide children with opportunities to engage in unstructured playtime, to be active, and provide access to nature. Nineteen studies looked at nature in the neighbourhood analyzing accessibility and diversity of land use

mix, street connectivity, walk and cycle infrastructure, neighbourhood aesthetics, public recreation centre, school grounds, parks or playgrounds, trails, beach or lake, vacant lot, family's yard and friend or relative's house. Studies on neighbourhood and nature have produced mixed results as one study found higher land use mix and gardens were not related to overall moderate-to vigorous physical activity (D 'haese, Dyck, De Bourdeaudhuij, Deforche, & Cardon, 2010) while one Canadian study found that living in neighbourhoods with greenspace consisting of meadows, trees, and shrubs, was positively associated with the amount of physical activity done during free-time outside of school time (Janssen & Rosu, 2015). Neighbourhoods with more sidewalks and parks leads to children spending two hours or less in front of screens, being more physically active, and engaging in more active transportation, than children living in neighbourhoods with perceived less sidewalks and parks (Carson, Kuhle, Spence, & Veugelers, 2010). The neighbourhood environment can influence children using active transportation as a mode of travel. Street trees can increase children's choice to walk to school (Larson, et al., 2009). These studies all demonstrate how the neighbourhood environment can play a pivotal role in effecting children's physical activity levels.

School

The final avenue that was shown to promote physical activity is the school environment. Nineteen studies were identified and produced conflicting results, but a number did find greenspace in schoolyards supporting of physical activity (Sugiyama et al., Dyment & Bell, 2007; Martensson et al., 2014). On the other hand studies also found that greenspace doesn't influence physical activity and that paved sport courts are more conducive to engaging physical activity behaviours (Powell, Woodfield, & Nevill, 2015; Farley et al., 2008; Wood, Gladwell, & Barton, 2014). Generally, results are mixed as soft surfaces like grass have been found to both increase and decrease physical activity (Cardon, Van Cauwenberghe, Labarque, Haerens, & De Bourdeaudhuij, 2008; Barton, Sandercock, Pretty, & Wood, 2015; Wood, Gladwell, & Barton, 2014). Dyment and Bell (2007) indicated that having diverse landscapes and having adequate play space is also important. In school yards, the levels of physical activity were influenced by the area or available facilities. Having a large amount of facilities in the schoolyards that students can pick from, increases the odds of secondary students being physically active (Haug, Torsheim, Sallis, & Samdal, 2010). Given that the results vary from study to study, this area needs to be further explored. School gardens were also found to influence physical activity, with participating students showing more moderate physical activity levels than non-participants. However, no significant difference was found for light and vigorous physical activity (Wells et al., 2014). After school and summer months are important unstructured times where children can be physically active and access nature. One nature-based after school program found that physical movement was increased in

summer programs and that an increase in physical movement was found during the after school program compared to children's time were at home (Kien & Chido, 2003).

1.3 Conclusion

The findings presented above provide us with an overview of research examining how nature can influence children's physical health and development. The vast majority of studies identified nature as having a positive influence on children's physical health. However, additional research is necessary to solidify this relationship. School yard designs is an area that still warrants attention, to establish what natural environment is best to promote physical activity, as the findings are conflicting. Examining outcomes by age and gender can help to create designs that reduce disparities in physical activity. Furthermore, the research demonstrates how school gardens can impact children's health by increasing their intake of fruits and vegetable.

1.4 Recommendations

Future Research

- Need comparisons of nature-based playgrounds versus traditional playgrounds to see how children with different opportunities engage in physical activity (Barton, et al., 2015)
- Further research is needed into the best type of school yard designs to promote children being physically active at school; school-based studies should also examine how school gardens can impact other health benefits beyond physical activity.
- Further research is needed using rigorous study designs, including using 'natural experiments' and longitudinal study designs to isolate effects of nature interventions.
- A critical need for more research using mixed-methods approaches which combine direct observations of children's behaviours in their local environments with data on health behaviours and outcomes
- Need more rigorous evaluations of the promotion and preservation of green space as an approach to address the issue of childhood obesity (Bell, et al.,2008)
- More research needed on seasonality and its impact on nature's influence on children; there is a noticeable lack of studies that take place in winter.
- More research is needed in non-urban settings, including rural and remote areas, as most work is focussed in urban settings.
- Research is needed on how nature exposure impacts other critical aspects of children's health such as sleep duration and sleep quality.
- There is a need to address the impacts of quality of natural spaces and specific types of vegetation on physical health outcomes

- Additional research is needed on how ‘blue space’ (e.g., water) as an element of nature benefits children’s health and well being
- There is a critical need to use more fine grained measures of location (e.g., using GPS) to assess more precisely children’s actual exposure to green space, not just green space available in broader neighbourhood.

Policy

- Zoning policies can be reformed to encourage outdoor space design to be more supporting of physical activities (Kurka, et al.,2015)
- Encourage school-based policies and approaches to promote physical activity in natural environments (Eyre, et al., 2014)
- Municipal policies can be enacted to add more green space to more neighbourhoods (i.e., more street trees, parks, gardens).
- Develop strategies to improve parent’s attitudes towards involving children in outdoor recreation programs allowing for children’s outdoor play time to increase (McFarland, et al.,2014)

Practice

- Urban/ City Planners:
    - Park-renewal/ renovations to make existing parks more attractive to users may facilitate increased amounts of physical activity (Veitch, et al., 2012; Cohen, et al., 2014; Veitch, et al., 2014; Martensson, et al., 2010; Edwards, et al., 2015)
    - Increase the number of trees and grass in public housing developments (Taylor, et al., 1998)
    - Specific allocation of green space in urban environments (Ebisu, et al., 2016)
    - Inclusion of community garden sites in park and recreation areas (Castro, et al., 2013)
- Health Promoters
    - Green school ground space and outdoor environments should be regarded as a highly effective intervention for children’s health (Dyment, et al., 2009; Pagels, et al., 2014)

2. Mental Health and Emotional Well-Being

2.1 Introduction

The World Health Organization (2005) defines child and adolescent mental health as "the capacity to achieve and maintain optimal psychological functioning and well-being". Good mental health during childhood is associated with emotional well-being, reaching developmental milestones, learning healthy social skills, developing sound family and peer relationships, developing a sense of identity and positive self-esteem, and learning resilience and how to cope with stress. Alternatively, the term mental health is also often used when referring to mental disorders associated with impaired brain or emotional functioning (Waddell McEwan, Peters, Hua, & Garland 2007). The most common child and adolescent mental disorder examined in the literature reviewed here is attention deficit/hyperactivity disorder (ADHD).

This summary of findings will highlight specific mental health and emotional well-being outcomes which have been associated with children's engagement with nature. In the studies included in this review, exposure to nature has been measured in a variety of ways, including: time spent in nature, frequency in nature, exposure to green space, proximity to green space, residential/school surrounding greenness, density of vegetation, access to green space (parks), and outdoor adventure camps or wilderness therapy programs. Outdoor adventure camps and wilderness therapy programs are alternative treatment programs where children are exposed to the natural environment as part of their therapy. These programs for the most part focus on vulnerable populations such as juvenile offenders, those suffering from addiction, or children with various mental health disorders.

2.2 Summary of Outcomes

Table 3: Number of Studies with Mental Health & Emotional Well-Being Outcomes

Outcome/Benefit	Number of Studies
Mental Health	**4**
Emotional Well-Being	**10**
Resilience	**4**
Self-Esteem	**8**
Stress	**2**
Quality of Life	**1**
SDQ[a]	**1**
Attention Deficit Hyperactivity Disorder	**10**

Behavioural Disorders	2

[a] SDQ: Strength and Difficulties Questionnaire

Mental Health

Four studies looked at an overall measure of mental health in children. Most authors agree that nature has a positive impact on children's mental health. Many recent studies have focused on outdoor camps and wilderness therapy programs to assess mental health. Three studies came to similar conclusions about the outcomes associated with camps and wilderness therapy programs: improvements in capacity to self-manage ill mental health and disorders (Pryor, Townsend, Maller, & Field, 2006); positive significant effects on clinical syndromes such as anxious feelings, depressive affects, and suicidal tendencies (Clark, Marmol, Cooley, & Gathercoal, 2004), as well as a significant improvement mental health constructs (Harper, Russell, Cooley, & Cupples, 2007). These programs generally target more vulnerable or at risk populations, and therefore should not be considered generalizable to the broader population.

Other measures of nature exposure found in the literature include proximity to city parks and residential greenness. In one study, farther distance between residential distance to and city parks was associated with poorer mental health in children whose mothers were classified as the lower maternal education group (Balseviciene et al., 2014). Conversely, in the same study, more residential greenness was associated with worse mental health in children whose mothers were classified as the higher maternal education group (Balseviciene et al., 2014). The contradictory findings in this one study highlight the need for greater attention on how nature's effects on children differs for different populations.

Emotional Well Being

Ten studies highlighted in this review assessed emotional well-being as an all encompassing term which included emotional health, emotional intelligence, emotional problems, and other variables.

Using the redesign of a schoolyard (experimental versus control), quality of the outdoor play environment, and children attending a forest school (experimental vs control) it has been shown that these "more green" environments improve children's emotional well-being (Kelz, Evans, & Röderer, 2015; Roe & Aspinall, 2011; Söderström et al., 2013). In another exposure to nature study, researchers found that children generally reported somewhat more positive feelings in the woods, or during natural exposure. The effect

size (0.12) indicates that this may be a significant finding (van den Berg & van den Berg, 2011).

Outdoor camps and wilderness therapy programs are again used in assessing nature exposure in relation to mental health and well-being. Moderate findings suggest that these types of programs show an increase in emotional intelligence and improvement in emotional problems (Harper et al., 2007; Opper, Maree, Fletcher, & Sommerville, 2014).

Amoly et al. (2014) reported a statistically significant inverse association between green space playing time and emotional symptoms. Likewise, a study by Flouri et al. (2014) found that neighbourhood green space has the potential to help children from poor families have better emotional health early in life. Unlike these positive associations, two studies found that residential and surrounding school greenness were not a significant predictors of children's emotional well-being (Balseviciene et al., 2014; Huynh, Craig, Janssen, & Pickett, 2013). Huynh et al. (2013), did however, find a small relationship between green space and positive emotional well-being in small cities, but this was not a significant trend.

The results for emotional health and proximity to major green spaces or parks were not conclusive in the study done by Amoly et al. (2014), while also not a significant predictor in either group studied by Balseviciene et al. (2014).

Resilience

Resiliency is defined as "the ability to effectively cope with challenges, stress, or adversity" (Whittington, Aspelmeier, & Budbill, 2016). A child who is resilient is, "an emotionally healthy individual who is able to successfully confront and negotiate a multitude of challenges, and effectively cope with obstacles, barriers, or setbacks" (Whittington et al., 2016). Emotional resilience is an important measure of children's mental health and emotional well-being and is assessed in a variety of child/youth populations. Outdoor adventure programs or camps have shown an immediate and maintained increase in overall resilience in certain populations (Ritchie, Wabano, Russell, Enosse, & Young, 2014; Whittington et al., 2016).

Resilience can be subdivided into measures of sense of mastery, relatedness, and emotional reactivity. It was found that adventure programs resulted in an increase in mastery (improved self-efficacy and coping skills; and relatedness (more comfortable interacting with others) and decrease in emotional reactivity (ability to manage emotions when upset; Whittington et al., 2016). Neighbourhood greenspace also predicted emotional resilience in poor children whose neighbourhoods had a higher density of greenspace relative to others in less green neighbourhoods (Flouri, Midouhas, & Joshi, 2014).

Self-Esteem

Self-esteem is important in addressing mental health as low self-esteem is very common in children and youth suffering from a mental illness (Reed et al., 2013). A variety of nature based programs have assessed how children's self-esteem is influenced by nature specific therapy or activities. Marginalized youth, juvenile offenders, adolescent dropouts, healthy school children, and those suffering from mental illness all are populations represented in this area of study (Barton, Sandercock, Pretty, & Wood, 2015; Cammack, Waliczek, & Zajicek, 2002; Hinds, 2011; Maller & Townsend, 2006; Reed et al., 2013; Romi & Kohan, 2004; Schell et al., 2012; Wood, Gladwell, & Barton, 2014). A number of studies have come to different conclusions on the effects outdoor camps or wilderness therapy programs have on self-esteem: Hinds (2011) found that there was no significant effect on self-esteem; Romi and Kohan (2004), found that there was an increase in self-esteem in the wilderness therapy group (experimental); however, this change was not significant compared to an alternative group in the residential program (control 1); Schell et al. (2012) found that the outdoor camp for those with a mental illness saw a significant improvement in self-esteem in comparison to the control group. Similar to the outdoor camps and wilderness therapy interventions horticulture programming for juvenile offenders has seen an increase in self-esteem pretest scores (Cammack et al., 2002).

Activities in nature have also been used as an exposure to assess self-esteem. No significant effects were seen on change in self-esteem as a result of a nature based orienteering intervention (Barton et al., 2015). Unlike Barton et al. (2015), Maller and Townsend (2006), found that perceptions of children's self-esteem as recorded by principals and teachers were positively affected by nature based activities in a school setting. Finally, school playing environment and green exercise were both assessed in relation to self-esteem in healthy school children to determine the effects on self-esteem. School playing environment and green exercise did not have additional improvements on self-esteem (Reed et al., 2013; Wood et al., 2014).

Stress

Feda et al. (2015) discovered an inverse association between perceived stress and access to parks in adolescent populations, even after controlling for socio-economic status and physical activity. The total percentage of parks within an 800m radius predicted further reductions in perceived stress. Wells and Evans (2003) found that residential greenness buffers the adverse impacts of stressful life events supporting nature's connection to children's stress.

Behavioural Disorders

Findings from Russell (2003) indicated that after individuals participated in an Outdoor Behavioural Healthcare Program, very similar to wilderness therapy, they saw a reduction on all subscales of the Youth Outcome Questionnaire of both the self-reported and parent assessment. Behavioural disorders in this study included Oppositional Defiant Disorder, substance disorders, and depression disorders. More difficulties or behaviour problems have been non-significantly associated with further distance to city parks as well increased residential greenness was associated with more problems (Balseviciene et al., 2014).

Health Related Quality of Life & Strengths and Difficulties Questionnaires

Taylor and Kuo (2011) used the Pediatric Quality of Life Inventory (PedsQL) to measure children's health-related quality of life. More open natural spaces (meaning smaller concentrations of trees) have also been shown to have a greater effect on symptoms of children with ADHD and hyperactivity relative to children without hyperactivity (Taylor & Kuo, 2011).

The strength and difficulties questionnaire (SDQ) is a validated behavioural screening tool for children ages 3 to 16 years. It is divided into 4 difficulties subscales including emotional symptoms, conduct problems, hyperactivity/inattention, and peer relationship problems, and finally a strength subscale for pro-social behaviour. Some papers have presented their results by each subscale others as a total SDQ score. Amoly et al. (2014) reported a statistically significant inverse association between green space playing time and SDQ total difficulties and residential surrounding greenness and SDQ total difficulties. For proximity to major green spaces, the results were not conclusive for total difficulties and each subscale.

Attention Deficit Hyperactivity Disorder (ADHD)

A large portion of the research collected for this review focused on nature's effect on children's ADHD/ADD symptoms. Surrounding greenness, types of green settings, activities in green settings, proximity to green spaces, and time spent in green space are all measures of exposure used for assessing ADHD/ADD.

Surrounding greenness was associated with a reduction in ADHD symptoms overall. Measuring surrounding greenness in a residential capacity resulted in lower ADHD and inattention symptoms (Amoly et al., 2014).

Green settings have also been shown to have a reduction on ADHD symptoms. A study done in the United States assessed the impact of green or natural settings on children who had been officially diagnosed with ADHD by a professional. Results were published on children's usual play environments and the after affects of different activities on children's overall ADHD symptoms. One of the papers published from this

study found that everyday play settings had an effect on overall symptom severity in children with ADHD, green settings having the largest positive impact (Taylor & Kuo, 2011). Interestingly, children who also identified as being hyperactive saw the benefit of green settings only in open green spaces, not big trees and grass (Taylor & Kuo, 2011). A second paper reported that green outdoor settings reduced symptoms of ADHD significantly more in comparison to built outdoor/indoor even when the activities were matched across each setting (Kuo & Taylor, 2004). Finally, a third paper found that children function better after activities in green settings and that the greener the setting the less severe the ADHD symptoms are (Faber Taylor, Kuo, & Sullivan, 2001). In addition to these studies, other results have been published on the effects of activities in green spaces.

A comparative analysis of a natural and built setting showed that children with ADHD had more difficulty concentrating in the city or town setting. Faber Taylor and Kuo (2009) measured concentration using a cognitive test called the Digit Span Backwards, and found that concentration after the walk in the park was better than after the walk through downtown and the neighbourhood settings. Similarly, van den Berg and van den Berg (2011) found that participants had more difficulty concentrating in the town setting in comparison to the woods, displaying few concentration problems in the woods.

There is conflicting evidence on the role proximity to green space plays on its association with ADHD. Residential proximity to green space was not associated with ADHD indicators in a study done by Amoly et al. (2014). However, it has also been shown that a larger distance to the nearest urban green space was associated with hyperactivity and inattention problems (Markevych et al., 2014). Furthermore, Balseviciene et al. (2014) found hyperactivity in children increased as they became further from city parks in the lower maternal education group. The majority of the research on ADD and ADHD is done with children between the ages of 7-12 years old, therefore further research is needed with children of different age groups, including preschool-aged children, as well as adolescents 13 years and older.

2.3 Conclusion

All of these studies that attempt to establish a link between nature and children's mental health and emotional well-being are, at present, inconsistent in their findings. An exception to this statement is the summary of results on ADHD. It is fairly clear that there is a consistent benefit of nature exposure for producing significant decrease in symptoms. Creating a more standardized measure for operationalizing nature is necessary to make these findings generalizable to the population. Understanding why some measures show significant positive changes in various outcomes, while others cause negative effects is another obstacle this research must overcome to generalize

the status of children's mental health and emotional well-being. Moving forward a variety of recommendations can be made based off of this review and are as follows:

2.4 Recommendations

Future Research

- There is a need for fine tuning measurement instruments to detect significant differences and change due to nature interventions
- Further research is needed using experimental and longitudinal study designs to identify impacts of nature programs and interventions on mental health
- Limited number of existing studies raises the need for replicating findings in similar settings with other populations and vice versa
- As many studies are based on small sample sizes, further studies are needed with larger sample sizes
- There is a need to address the impacts of quality of green spaces and specific types of vegetation
- There is a need to compare different aspects of wilderness therapy, outdoor adventure camps, and other nature programs to determine which are the most effective
- What types of parks are most beneficial to mental health and emotional well-being to guide municipal planning
- Need to explore the effects of nature and the exposure-response modifying factors on outcome (Balseviciene et al., 2014)
- There is a need for qualitative research (i.e. interviews and focus groups) to be undertaken as part of larger mixed-methods studies, to gain a better understanding of the importance of nature for children's mental health
- There is a critical need to use more fine grained measures of locality and exposure to greenery (e.g., using GPS) to assess more precisely the proximity of children to green space, not just in children's immediate neighbourhoods (Flouri et al., 2014)
- Need to measure the duration of the effects that different doses of nature have on benefits for children (Faber Taylor et al., 2001)
- Need for more studies assessing everyday exposure to nature versus specific structured interactions with nature
- Need additional research focusing on benefits of nature on children's anxiety and depression, especially in adolescent populations

Policy

- Development of policies at all levels of government to support greener environments for children
- Introduce nature contact into school policies and curriculums as points of intervention to help improve long term mental health and emotional well-being (Dadvand et al., 2015; Flouri et al., 2014; Markevych et al., 2014; van den Berg & van den Berg, 2011)
- The effects of nature on children's health can be more significant in vulnerable/marginalized populations and therefore should be emphasized when creating public policy (Huynh et al., 2013; Wells & Evans, 2003)

Practice

- Green urban planning should be promoted as a tool for supporting children's mental health and emotional well-being (Balseviciene et al., 2014)
- Planners and designers need to build safe, accessible parks within neighbourhoods home to families and children (Feda et al., 2015; Wells, 2000)
- Nature based interventions should be implemented alongside playground-based interventions to allow all children equal opportunities as well as facilitate different activities (Barton, Sandercock, Pretty, & Wood, 2015; van den Berg & van den Berg, 2011)
- Continued multi-disciplinary efforts are needed to incorporate urban nature and ecological planning considerations into decision making processes (Kim, Lee, & Sohn, 2016)
- Health care practitioners who work with families on a regular basis should emphasize the impact nature has on children's health

3. Social and Cognitive Development

3.1 Introduction

Social and cognitive development can include different types of outcomes including learning, communication skills, and relationship development. The present review identified various outcomes associated with social and cognitive development, such as memory, self-concept, self-worth, behaviour, peer relationships, focus, attention, and self-discipline. One of the most common topics identified was education, which included academic achievement, academic performance, and academic success. Table 1 illustrates the different outcomes/benefits identified and how many studies explored for each one. The articles included in this review studied these outcomes/benefits in association to various components of nature. The most common exposure to nature included: gardens, parks, greenness, school gardens, forest schools, views of nature, outdoor learning, outdoor camps, wooded areas, trees, and vegetation. The findings for each outcome/benefit are further explained throughout this section to provide information on the areas of research explored.

3.2 Summary of Outcomes

Table 4: Number of Studies with Social and Cognitive Development Outcomes

Outcome/Benefit	Number of Studies
Memory	**1**
Academic Achievement, Performance, Success	**8**
Cognitive Function	**3**
Behaviour	**12**
Self-Concept	**1**
Self-Worth	**2**
Relationships	**9**
Focus and Attentional Capacities	**5**
Self-Discipline	**4**

Memory

The first outcome identified under cognitive development, is memory. The study examined, longitudinally, how exposure to green space influenced primary schoolchildren's cognitive development, more specifically their memory and

inattentiveness (Dadvand, Nieuwenhuijsen, Esnaola, Forns, Basagana, Alvarez-Pedrerol, et al., 2015). Green space included greenness surrounding the home, surrounding the commuting route between home and school, and greenness within and around school boundaries. A total surrounding greenness index was also applied by averaging all three components of greenness. Greenness within and surrounding school boundaries, commuting greenness, as well as the total surrounding greenness index were associated with an enhancement in memory as well as a decrease in inattentiveness. No association was recognized between residential greenness and this component of cognitive development.

Academic Achievement/Performance

Multiple studies looked at the important role nature can play in education, through various avenues (e.g., outdoor learning, forest schools, garden-based learning). School-gardens can be used for academic instructions, often used for teaching science, environmental studies, and nutrition (Graham, Beall, Lussier, McLanghlin, & Zidenber-Cherr, 2005). Outdoor environmental educational programmes, that provide direct contact with nature, helps foster children's cognitive achievement (Dieser & Bogner, 2015). The first avenue, examined by eight studies, looked at the influence of nature on children's academic achievement/performance. When comparing outdoor teaching to traditional classroom instruction, children in the outdoor teaching group improved their performance in mathematical skills more than the traditional classroom group (Fagerstam & Samuelsson, 2014). The outdoor lesson often included direct contact with trees, stones, and sticks to enhance learning. Furthermore, research with elementary school children showed students that were exposed to more greenness around their school had better academic performance in both Math and English (Wu, McNeeley, Cedeno-Laurent, Pan, Adamkiewicz, Dominici et al., 2014). Nature's influence also reaches at-risk youth and can impact their educational success (Ruiz-Gallardo, Verde, & Valdes, 2013). A garden-based learning project was developed with disruptive and low-performance secondary school students. The garden-based learning program proved to be successful at increasing the number of school subjects the participants passed in comparison to the previous year. In the previous year the majority of students failed five or more subjects; however, after the garden-based learning program, nearly all students (93%) failed two or fewer subjects. In addition, drop-out rates decreased. Echoing these results, Block, Gibbs, and Staiger (2012) found that a school garden learning program helped children who were deemed as "non-academic" or as having "challenging" behaviour to find success at school. Contrary, Fox and Avramidis (2003) found conflicting results when examining outdoor learning on children with behavioural problems. The conflicting findings demonstrates the need for further research to fully understand the impact that outdoor learning can have on children with behavioural and disruptive problems.

The findings above demonstrate how contact with nature can impact academic performance, this impact is also observed by simply having views of natural landscapes from schools. Matsuoka (2010) showed the natural environment around a high school campus influenced student's achievement. School grounds composed of mowed grass and parking lots are associated with poorer student performance, compared to school grounds composed primarily of trees and shrubs (Matsuoka, 2010). Research indicated that classrooms and lunch cafeterias with large windows looking out onto nature, positively impacted student's academic success. Nature and green space can play a pivotal role in helping children success in their academic life, whether it be through direct contact by having classrooms in the outdoors or by being able to look out into nature.

Cognitive Function

The idea of nature's impact on education is further explored through forest schools, which have had an increased popularity in the UK. A forest school is defined as "inspirational process that offers children, young people, and adults regular opportunities to achieve and develop confidence and self-esteem through hand on learning experiences in a woodland environment" (Murray & O'Brien, 2005; Forest Education Initiative 2007). Forest schools can impact children's development, in various ways, such as, improving social skills by allowing children to be part of a team and work with others on specific tasks (O'Brien, 2009). Furthermore, forest schools provided an avenue for children to use their imagination more openly which allowed for an improvement in motivation skills and concentration, as they were encouraged to initiate teaching (O'Brien, 2009). Case studies of forest schools in England and Wales demonstrated that forest schools increase children's self-esteem and confidence, children engage in work co-operatively with others, and can lead to helping in the development of language and communication skills (O'Brien & Murray, 2007). Forest schools are shown to positively influence student's cognitive function in terms of energy, hedonic state, stress, and anger (Roe & Aspinall, 2011). This positive influence was greater for students who were deemed to have poor behaviour. Again supporting the fact that outdoor learning environments can be beneficial for all students, especially those who are have behavioural problems. Additionally, cognitive dimensions of project planning (efficacy and support) were examined between traditional school settings and forest schools. Although no significant differences were found, a trend was found towards more positive reflection on personal projects, after a day in the forest school (Roe & Aspinall, 2011).

Behaviour

In this review, the term behaviour incorporates social behaviour, as in social interactions between children, in addition to how nature impact children's behavioural problems.

Findings for pro-social behaviour or sociability are somewhat conflicting. Two studies found that there were no significant changes in sociability in children at outdoor camps (Hinds, 2011; Schell, Cotton, & Luxmoore, 2012). However, Balseviciene et al. (2014) found differences within two maternal education groups. The lower education group saw pro-social behaviour increase with proximity to parks while the higher maternal education group saw children increase pro-social behaviour with less residential greenness. Annual beach attendance had an inverse association with pro-social behaviour (Amoly et al., 2014). Finally, children participating in a school gardening program showed higher sociability in comparison to a control group without the program (Kim, Park, Song, & Son, 2012). These conflicting results could be due to the different age range of the participants. The two studies that did not find significant changes involved adolescents 12 years old and older, whereas the other studies involved children 7-10 years old. Therefore, it could be that the impact of nature on pro-social behaviour differs according to age. However, it could also be that different types of nature have different impacts on pro-social behaviour among children, even if analyses control for age. Another study found that children living further away from green space, had more overall behavioural problems, than those living closer to green space (Markevych, et al., 2014) and that children with access to gardens and parks have fewer conduct problems (Flouri, Midouhas, & Joshi, 2014). Wilderness therapies have also shown preliminary success at decreasing behavioural problems in adolescents (Harper, et al. 2007) and having a significant positive effect on maladaptive behaviour (Clark, Marmol, Cooley, & Gathercoal, 2004). These findings demonstrate the complexity of research on nature's impact on children's behaviours.

Self-concept

Within social and cognitive development, the outcome of self-concept was identified in one study. Self-concept was measured globally incorporating the following subscales: social, competence, affect, academic, family, and physical (White, 2012). An outdoor adventure learning camp, was found to significantly change adolescence's self-concept (White, 2012).

Self-Worth and Identity Complexity

A wilderness program comprised of camping and backpacking through the woods, provided positive changes in adolescent's identity complexity and provided them with a greater sense of purpose and self-worth (Norton Wisner, Krugh, & Penn, 2014). Outdoor adventure learning programs led to significant increases in self-efficacy (Ooko, Muthomi, & Odhiambo, 2015).

Relationships

One component of social development is the construct of ‘relationships’ with others. This can include either peer relationships, inter-group relationships, as well as interpersonal relationships. Amoly et al. (2014) reported a statistically significant inverse association between green space playing time and annual beach attendance and peer relationship problems. Other studies found that children living further from parks or urban green spaces experience more peer problems (Balseviciene et al., 2014; Markevych, et al., 2014). The amount and frequency with which parents took their children to neighbourhood green spaces was related to fewer peer problems (Flouri, Midouhas, & Joshi, 2014). However, according to Balseviciene et al. (2014) residential greenness did not have a significant impact on peer problems. School gardens can have positive effects on interpersonal relationships, specifically for 12 to 13 year olds (Waliczek, Bradley, & Zajicek, 2001) while outdoor adventure learning programs increased inter-group relations (Ooko Muthomi, & Odhiambo, 2015). The inconsistencies found between the studies provide opportunities for future research.

Focus and Attentional Capacities

Five studies examined how nature and greenness can play a factor on children’s focus and attention. One study examined whether children who were moved into new housing surrounded by a green natural environment had any changes in their ability to focus and directed attention capacities (Wells, 2002). The natural environment around a home was found to affect children’s cognitive function. Children who were exposed to the least amount of natural environment in the pre-move made the biggest increase in the attentional skill post move. A second study found that children in preschools with large, integrated, and green outdoor environments, containing large area of trees, shrubbery, and hilly terrains have higher attention. Green outdoor environment, correlated to the attention of preschool children (Martensson, Boldemann, Soderstrom, Blennow, Englund, & Grahn, 2009). Continuing with the same age group (4-7 year olds), outdoor classrooms were found to help children remain on task, listen, and focus (Maynard, Waters, & Clement, 2013). Furthermore, a study conducted with 8-12 year olds found that school gardens improved children’s attention (Block, Gibbs, & Staiger, 2012). An avenue for further exploration would be the influence of nature on attention and focus of teenagers.

Self-Discipline

For this outcome of social and cognitive development, self-discipline grouped together impulses, gratifications, and concentration. Greener views from the home can have positive associations with children, in regards to self-discipline. For girls, having a greener view from their home significantly and positively predicted impulse inhibition (Faber-Taylor, Kuo, & Sullivan, 2002), explaining approximately 5% of the variance in impulse inhibition scores. In regards to boys, there was a slight increase for impulse

inhibition associated with views, however this was not a significant relationship. Girls with greener views from their home were able to delay instant gratification better than girls with less green views. The same was found with concentration, demonstrating that greener views increased girl's concentration levels. For boys, although the links between views of greenspace and self-discipline were positive, they weren't strong links, demonstrating that greener views from the home has a greater impact for girls than boys when it comes to concentration, impulses, and gratification. Another study found that walking in a park led to better concentration compared to walking downtown or in a neighbourhood, in children with ADHD (Faber Taylor, & Kuo, 2009). Furthermore, children with ADD/ADHD concentrate more easily in wooded areas compared to in town (van den berg & van den berg, 2010). Similar results were found with children improved their concentration at school while participating in forest schools (O'Brien, 2009). In terms of self-discipline the findings suggest gender differences occur when the exposure to nature is through views of nature instead of direct contact.

3.3 Conclusion

The studies presented in this review indicate how nature can have a positive impact on various components of social and cognitive development. The vast majority of the research is based on how nature can be an asset in children's academic learning and success, as well as its role on children's behaviour. Future research is still need to further explore nature's role in social and cognitive development.

3.4 Recommendations

Future Research

- Future research should address how outdoor learning can benefit students with behavioural problems in schools
- More empirical evidence is needed for the benefits of school gardens on children's social, cognitive, and academic development
- As most research is focused on school environments, more research is needed examining the impact of nature in children's home and neighbourhood environment.
- Further examination required into how different types of nature (e.g., trees, gardens) and types of exposure (i.e., direct contact vs. views) impact outcomes
- More research examining how much exposure to nature is needed to see changes in children
- More research using objective measures of nature/green space (i.e., NDVI; GIS)
- Longitudinal studies examining the impact of nature on social and cognitive development throughout childhood

Policy

- Introduction of provincial or municipal policies (e.g., through the Planning Act and Official Plans) to ensure that trees and woodlands are planted in all residential environments
- Enact education policies at provincial and/or school board levels to introduce nature teaching into curriculums (Faber-Taylor & Kuo, 2009).
- Having outdoor classrooms integrated into the curriculum as they can be a compliment to traditional classroom learning (O'Brien, 2009)
- School policies to have students participate in the upkeep of gardens (e.g., plant the seeds, water the plants, see how things grow) could provide them with a sense of confidence, belonging, control and self-discipline.

Practice

- Enhancing school grounds to incorporate more greenery; planting trees, flowers, and gardens

- The planning and building of new schools should consider incorporation of nature (e.g., trees) surrounding the school, and have large windows in classrooms and cafeterias looking out into the surrounding green space (Faber-Taylor, Kuo, & Sullivan, 2002)
- Keeping existing tress when homes are constructed and including grass areas in housing complexes (Wells, 2000)

Conclusion

This report elucidates how the body of literature linking nature exposure and children's health and well-being has continued to grow over the past decade or so, with a dramatic spike in the last two years (Appendix F). The present report provides information on the benefits of nature for children's physical health and development, mental health and emotional well-being, and social and cognitive development. The information provided in this report indicated the numerous ways in which nature can benefit children and offers avenues to pursue in order to continue exploring this relationship.

In regards to physical health and development, physical activity was the most common outcome measured. The research, for the most part, demonstrates that elements of nature can provide an important pathway for children to be physically active. Given the decline in the physical activity levels and increase in screen time over the childhood years, this is an important finding. Children who live near parks or greenspace are more likely to engage in physical activity in those areas. Neighbourhoods with more street trees can entice children to use active modes of transportation to get to and from school, which can provide good daily physical activity. One area that highlighted conflicting results was school yard designs, as some studies showed green space in school yards as increasing physical activity while other studies found opposite results. Given the conflicting results, it is an area that needs to be further explored to be able to understand how to engage children in school yards to partake in physical activity. The review also illustrated the positive benefits of the natural environments on children's obesity rates and BMI levels.

Following all the benefits to children's physical health, this review also established the benefits of nature on children's mental health. The vast majority of the studies identified focused on children with ADD or ADHD, and how nature can help minimize their symptoms. Proximity to parks or greenspace was mostly found to be positively associated with mental health and emotional well-being. Furthermore, studies showed varying results with how nature can impact mental health and emotional well-being. There lies a research gap in studies examining nature's influence on depression and anxiety in adolescents. This area is important as depression and anxiety increase in prevalence, and if nature exposure can be beneficial, it would be an important finding.

Finally, exposure to nature showed multiple benefits for children's social and cognitive development. The main area of focus seems to be on how nature can benefit children in educational settings. Whether the outcome is increased academic achievement/performance, or enhanced cognitive function to improve focus and attentiveness during lessons, nature exposure seems to play a positive role. The idea of bringing traditional classrooms into the outdoors seems to be a popular trend with demonstrable benefit, and perhaps should be integrated into school curricula. Another

main area of focus was the influence that nature exposure can have on children's behaviour. Research indicates that behavioural problems and conduct problems were diminished when living in proximity to natural environments; however, conflicting results were found between studies, supporting the need for further research in this area.

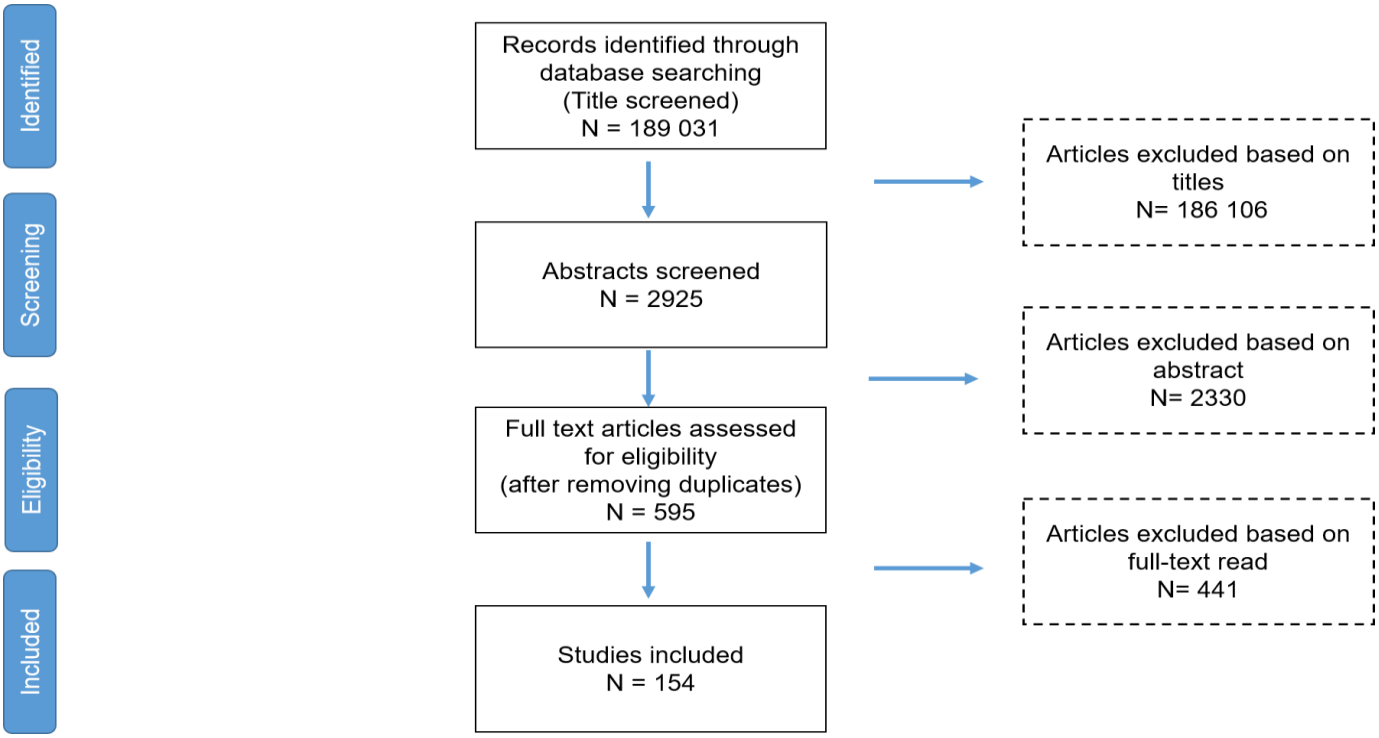
As highlighted by the recommendation section of each separate review, there are several areas to continue to explore moving forward on the topic of children and nature. There are avenues for researchers to provide us with the knowledge on the direct benefits of interacting with nature. Professionals/planners can put into practice the recommendations identified through the research, whether they involve interventions to change health care or greening of environments. Finally, there are avenues for policy makers at multiple levels to make concrete statements and policy to ensure that people, specifically children, can totally partake in the full range of benefits that contact with nature can provide them. It is also important that researchers connect with policy makers and planners to rigorously evaluate the impact of these natural environment exposure changes on children's health. Given all of the benefits that nature can have on children, from physical and mental health, to social and cognitive development, it is easy to see how important it is to get children outside and into nature.

Appendix A: Search Terms

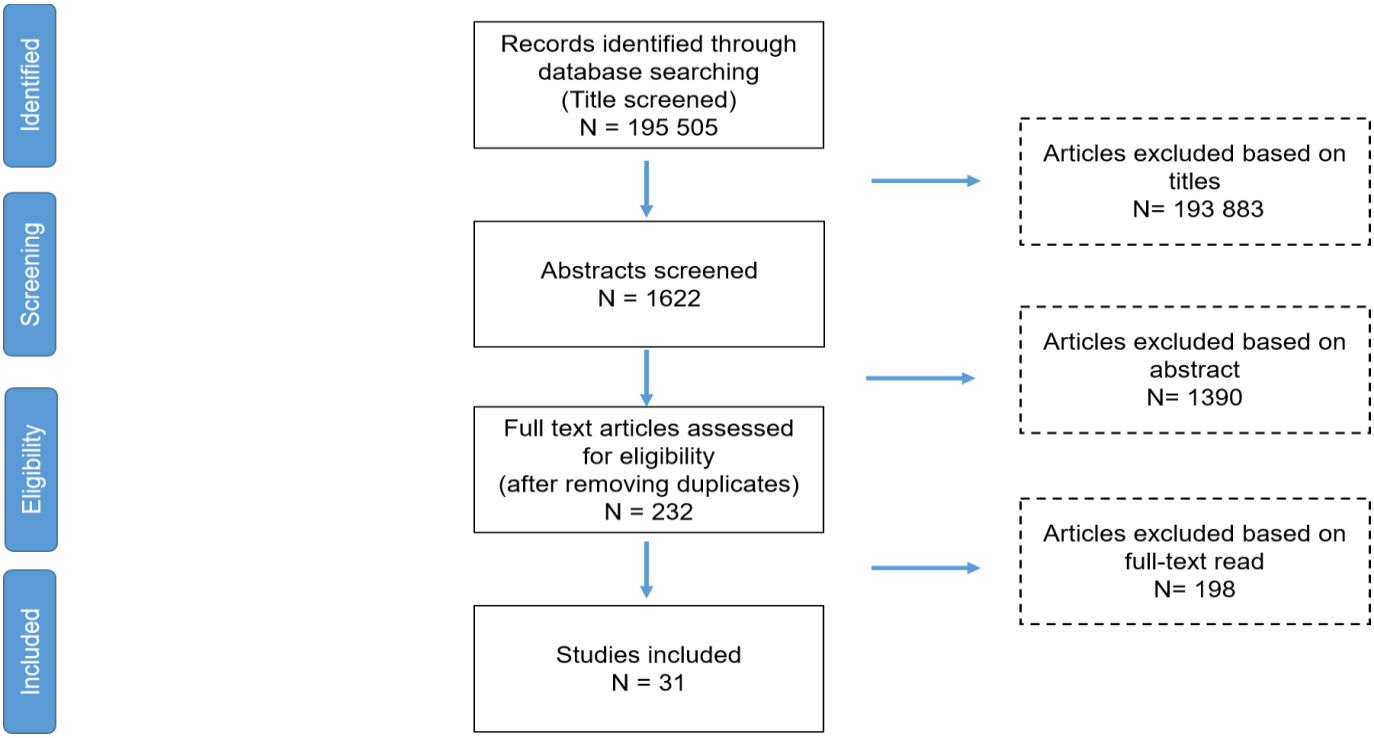
Nature	natur* OR green* OR “green space” OR greenspace OR “natural environment” OR “blue space” OR “open space” OR tree* OR outdoor* OR outside OR park* OR forest* OR wildlife* OR wilderness OR wood* OR plant* OR garden* OR vegetation OR landscape OR playground
Child (participant)	child* OR youth OR adolescen* OR teen* OR babies OR infant* OR toddler* OR preschooler*
Outcome: Physical Health and Development	“physical activit*” OR “physical literacy” OR walk OR play OR recreation OR exercise OR sport* OR active* OR blood lipids OR “physical health” OR “sedentary activity” OR “sedentary behaviour” OR “sedentary time” OR growth OR OR weight OR overweight OR obes* OR BMI
Outcome: Mental Health and Emotional Well-Being	“mental health” OR stress OR well-being OR “psychological well-being” OR emotion* OR coping OR anxiety OR anxious OR sleep OR mood OR “mood disorder” OR ADD OR ADHD OR “attention deficit disorder” OR autism OR depression OR schizo* OR tourettes OR “obsessive compulsive disorder” OR bipolar OR “depressive symptoms” OR “psychological distress” OR flourishing OR languishing OR behaviour OR behavior OR resiliency OR self-esteem OR self-confidence
Outcome: Social and Cognitive Development	“social development” OR “cognitive development” OR “child development” OR “intellectual development” OR neurodevelopment OR “socioemotional development” OR “developmental psychopathology” OR education OR focus OR attention OR “attentional capacities” OR language OR learning OR communication OR “academic performance” OR “academic achievement” OR self-discipline OR “executive function” OR “effortful control” OR “cognitive control” OR “inhibitory control” OR “self-regulation” OR “emotion regulation”

Appendix B: Flow Diagrams (PRISMA Format)

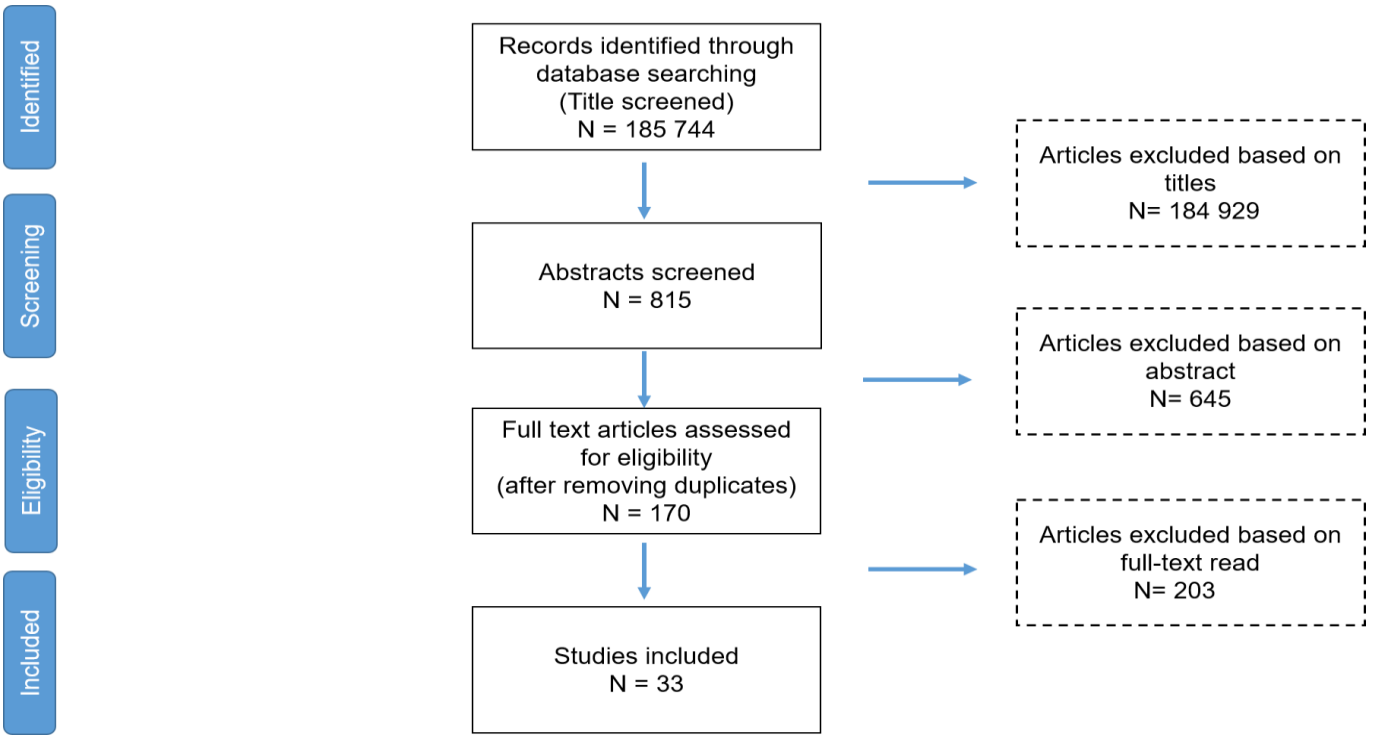
Physical Health and Development



Mental Health and Emotional Well-Being



Social and Cognitive Development



Appendix C: Summary of Findings related to Physical Health and Development

Table C1: Summary of Article Characteristics

	Sample Characteristics				Study Characteristics		
Article #	**Location (Country)**	**Ages (years)**	**Sex**	**N**	**Element of Nature**	**Exposure Type**	**Outcome/Benefit**
8	United Kingdom	10.2 +/- 0.3	M/F	854	Parks	Visits to Parks	Sedentary behaviour
117	Greek-Cypriot	11-12	M/F	256	Gardens	Availability of Garden	Physical activity
14	England	8.84	M/F	52	Nature	School based nature orienteering	Physical activity
104	United States	6-11	M/F	682	Parks	Outdoor Parks and Rec Facilities	Physical activity
34	Western Australia	10-12 Dog Walkers	M/F	727	Neighbourhood	Time in neighbourhood and yard	Physical activity
107	United States	6-12	M/F	678	Parks	Nature options: land-use mix & recreation facility/park access	Physical activity
184	United States	6-11	M/F	724	Park	Safety from crime, higher aesthetics, better walking/cycling facilities and proximity to play area	Physical activity

137	United States	4-5	M/F	50 at baseline 57 post intervention	Playground	Playground space, looping cycle path and grass hill	Physical activity
43	Belgium	9-12	M/F	606	Greenspace	Street connectivity, land-use mix, crime safety, residential density, Garden	Physical activity
212	United Kingdom	8-9	M/F	25	School Playing Environment	School field vs playground	Physical activity
86	United States	JK-8	M/F	43	School gardens	Time spent	Physical activity Fruits and vegetable consumption
138	Canada	Gr. 6-10	M/F	9114	Neighborhood parks	Availability and access to neighborhood parks and recreational facilities	Physical activity
66	United States	Gr. 2-8	M/F	Spring= 373, fall=381, winter=309	Schoolyards	Where and how play occurs	Physical activity
5	United States	5-11	M/F	106	School playground	Variance in features	Physical activity
39	United States	Children and teenagers	M/F	922	Parks	Renovations and Park based activity	Physical activity
166	United States	0-12	M/F	432	Playgrounds	Micro-environmental changes to encourage play	Physical activity
160	United States	>12 & 13-20	M/F	3055	Parks	Demographic characteristics linked to park behaviours	Physical activity
51	Australia & Canada	JK- Gr. 6, JK- Gr.8	M/F	466	School playgrounds	School ground designs	Physical activity

198	Australia	2-18	M/F	741	Parks	Renovations and improvements	Physical activity
121	Australia	5-12	M/F	~400	School playgrounds	Design influences	Physical activity
95	United States	2-12, 13-20	M/F	2352	Parks		Physical activity
82	United States	>12, 12-19	M/F	83	Neighborhood parks	Access and use	Physical activity
21	United States	>18	M/F	2712	Parks and playgrounds	Use and sex differences	Physical activity
15	United States	>12	M/F	2462	Green spaces	Use and associations with categories of PA	Physical activity
37	United States	>18	M/F	446	Pocket parks	Access and use	BMI/Obesity
159	United States	Infancy-12, 13-20	M/F	1184	Parks	Use	Physical activity
17	United States	2-12, 13-20	M/F	1934, 520	Parks	Demographic variations in use	Physical activity
188	United States	0-19	M/F	262	Green spaces	Level of vegetation	Physical activity
155	United Kingdom	7-10	M/F	82	School playgrounds	Assessment of use and types of play	Physical activity
103	United States	>12, 13-19	M/F	7413	Parks	Park development and renovation	Physical activity
181	United States	Grade 3	M/F	44	Class Garden	Gardening	Vegetable Consumption Physical Activity BMI/Obesity
33	United States	2-15	M/F	95	Community Gardens	Weekly Gardening Sessions	Fruit and Vegetable Consumption BMI/Obesity
78	Unites States	Grade 4	M/F	592	School Gardens	Purpose and use of gardens in schools, relating to gardens and nutrition	Eating behaviour
113	United states	8-15	M/F	Pre N =96 Post N =66	School Garden	Planting and harvesting gardens	Eating behaviour
147	United States	Grade 2	M/F	115	School Garden	Maintaining Garden	Fruit and Vegetable Consumption
63	South Africa	2-5	M/F	165	Home Garden	home-gardening program improved the	Food Consumption

						dietary intakes of yellow and dark-green leafy vegetable	
132	United States	7-13	M/F	801	Youth Gardens	Increasing access to fruits and vegetables through youth gardening	Fruit and Vegetable Consumption
194	New Zealand	Grade 9- 13	M/F	8500	School Gardens	Presence of a school garden	Eating Behaviours Fruits and vegetable consumption BMI/Obesity
135	Australia	11-12	M/F	127	Garden	Gardening Programme	Fruits and vegetable consumption
36	Australia	5-6 and 10-12	M/F	548	Outdoors	Time Spent Outside	Physical Activity BMI/Obesity
3	United States	Under 18	M/F	42278	Recreational Parks	Access to recreational parks and facilities	BMI/Obesity
65	United States	10-17	M/F	44015	Parks/ Playground	Impact of neighbourhood parks/ playgrounds	BMI/Obesity
203	United States	4- 12	M/F	12118	Parks	Proximity to house	BMI/ Obesity
211	United States	9-10	M/F	3173	Parks	Distances to parks	BMI/Obesity
154	Canada	2-9 and 10-17	M/F	108	Parks	Availability	BMI/Obesity
133	United States	2- 11	M/F	6669	Park/playground	Recreational access	BMI/Obesity
153	Canada	3- 8	M/F	6772	Parks/ green space	Spatial access to parks/ green space	BMI/Obesity
199	Canada	Grade 5	M/F	4 298	Parks and Playgrounds	Access to parks and play grounds	BMI/Obesity
201	United States	Grade 6-12	M/F	2682	Neighbourhood greenness	Exposure to variables	BMI/Obesity
179	United States	0-17	M/F	91642	Parks and Playgrounds	Access to parks and playgrounds	BMI/Obesity
88	Netherlands	5-6	M/F	3469	Greenspace	Satisfaction with greenspace	BMI/Obesity
16	United States	3-16	M/F	3831	Greenness	normalized difference vegetation index (NDVI)	BMI/Obesity

176	Australia	6-7	M/F	4423	Greenspace	Neighbourhood greenspace	BMI/Obesity
45	Spain	9-12	M/F	3322	Residential surrounding greenness	Proximity to green space	BMI/Obesity
32	France	12	M/F	3327	PA facilities (urban and nature)	spatial accessibility	BMI/Obesity
115	United States	3-18	M/F	7334	Neighbourhood vegetation	NDVI	BMI/Obesity
120	United States	3-5	M/F	11562	Street Trees	Density of Street Trees	BMI/Obesity
162	Brazil	14-18 years old	M/F	1718	Park	Number of days/week that physical activities were performed in parks	Physical Activity
50	Canada	Elementary school aged children	M/F	59 schools	School yard	Greening school yard	Physical activity
127	Sweden	10-11 years old and 12-13 years old	M/F	197	Greenery	Frequency of PA	Physical activity
24	Switzerland	6-7, 9-10 and 13-14	M/F	1081	Greenspace (park, wood, garden)	Proximity	Physical activity
82	United States	Children/ teenagers	M/F	2208	Parks	Time spent in PA	Physical activity
91	Canada	11-13 years old	M/F	5138	Greenspace	Proximity	Physical activity
79	United States	2-5 years old	M/F	365	Neighbourhood greenness	NDVI	Physical activity
80	United States	5-18 11-18	M/F	211	Parks	Proximity to parks	Physical activity
23	United States	Grade 7-12	M/F	10773	Parks	GIS	Physical Activity
9	United States	12-17 years old	M/F	4010	Parks	Access to parks	Physical activity
10	United states	12-17 years old	M/F	3638	Parks	Access to parks	Physical Activity

7	United States	8-14 years old	M/F	93	Parks	Density	BMI/Obesity
30	Canada	Grade5	M/F	148	Parks	Amount of parks in neighbourhood	Physical activity
149	Nepal	15-20 years old	M/F	405	Parks	Proximity to parks	Physical activity
72	Australia	10-12 year olds	M/F	677	Open spaces	Frequency	Physical activity
108	Finland	10-12 and 13-15 year old	M/F	946	Neighbourhood Greenness	Proximity to greenness	Health
69	Norway	6 year olds	M/F	70	School yard	Use of school yard for play	Physical activity
210	United States	14-15 years old and 17-18 years old	MF	71 counties	Parkland and Forest	Density	Physical activity
56	Australia	12-15 year old	M/F	1304	Parks and Beaches	Proximity to park and beaches	Physical activity
130	United States	3-5 year old	M/F	69	Outdoor	Time spent in outdoor nature	Physical activity
53	United States	3-12 years old (parents of)	M/F	225	Parks	Proximity	Physical activity
42	United States	6-11 year olds	M/F	1423	Parks	Use of park	Physical activity
49	United States	8-14 year olds	M/F	135	Parks	Use of park and proximity to park	Physical activity
55	Australia	12-15 year old	M/F	1304	Parks	NDVI	Physical activity
57	United States	8- 15 year olds	M/F	58	Parks	Proximity	Physical activity

111	United States	0-18 years old	M/F	9072	Parks	Time spent in parks	Physical activity
110	United States	6-15 years old and 16-19 years old	M/F	1450	Outdoor	Time spent	Physical activity
158	New Zealand	5-10 years old	M/F	184	Parks	Time spent	Physical activity
190	Australia	8-9 years old and 13-15 years old	M/F	497	Open spaces	Proximity to open spaces	Physical activity
207	United Kingdom	10-11 years old	M/F	1307	Greenspace	Time spent	Physical activity
197	Australia	5-6 year olds	M/F	171	Open spaces	Neighbourhood open spaces	Sedentary behaviour
168	United States	4-7 year olds	M/F	59	Parks	Proximity	Physical activity
4	Denmark	10-15 years old	M/F	523	School playground - Natural area and grass area	Time spent	Physical activity
22	Sweden	4-6 year old	M/F	197	Vegetation	Step count	Physical activity
146	Sweden	7-14 year olds	M/F	196	Greenspace	Time spent	Physical activity
163	United States	Grades 9-12	M/F	350	Park	Availability and Use of park	Physical activity
29	Belgium	4-5 year olds	M/F	783	School yard	Time spent	Physical activity
175	Australia	4-5 year olds	M/F	2600	Greenspace	Neighbourhood greenspace	Physical activity

93	United States	8-14 years old	M/F	147	Greenspace	Proximity	Physical activity
40	United States	5-8 year olds	M/F	539	Parks /Playgrounds, neighbourhood greenness	Time spent	Physical activity
99	United States	10-12 years old	M/F	12	Gardens	Time spent	Physical activity
206	United States	8-12 year olds	M/F	124	School Gardens	Time spent	Physical activity
11	United States	8-17 year olds	M/F	94	Parks	Time spent	Physical activity
38	United States	11-12 year olds	F	1556	Parks	Proximity	Physical activity
139	United States	11-15 years old	M/F	871	Neighbourhood environment	Proximity	Physical activity
150	Denmark	10-13 year olds	M/F	81	Schoolyard	Time spent	Physical activity
94	United Kingdom	9-10 year olds	M/F	100	Land use mix	Time spent	Physical activity
25	Germany	2-9 year olds	M/F	400	Open spaces	Time spent	Physical activity
118	United States	Preschool children	M/F	428	Street Trees Parks	Proximity	Physical activity BMI/Obesity
101	United States	9-11 year olds	M/F	92	Greenery	Proximity	Health
109	Canada	11-13 year olds	M/F	810	Land use mix	Proximity	Physical Activity
18	Ireland Scotland	13-16 year olds	M/F	1493	Outdoors	Time spent	Physical activity
27	United States	5- 11 year olds	M/F	94	Land use	Density	BMI/Obesity

52	United States		M/F	239811	Greenspace	Exposure to green space	BMI/Obesity
58	Various European countries	6-18 years old	M/F	1184	Greenspace	Access to green space	BMI/Obesity
68	Norway	5-7 year olds	M/F	29	Natural environment	Exposure to nature/forest	Motor development & skills
60	United Kingdom	7-9 year olds	M/F	96	Green space	Time spent	Physical activity
131	Scotland	8-9 year olds	M/F	39	Green space	Time spent	Physical activity
178	Portugal	10-13	M/F	24	Seasons	Seasonal variations influence on time spent	Physical activity
180	Australia	15	M/F	1021	Natural Environment	School based programme	BMI/ Obesity
183	Australia	3-5 year olds	M/F	89	Outdoors (grass and mulch)	Time spent	Physical activity
140	United States	11-15	M/F	799	Parks	Proximity	Physical Activity
173	United States	Grade 1-12	M/F	781	Parks	Frequency of visits	Physical Activity
193	Canada	11-13	M/F	811	Parks	Land coverage	Physical activity
156	Netherlands	12-15 year old	M/F	654	Parks	Availability	Physical activity
90	United States	10-14 year old	M	210	Trees	Exposure to trees	Physical activity
195	New Zealand	13-17 years old	M/F	9699	Parks	Access	Physical activity
189	Australia	5-6 year olds 10-12 year old	M/F	1210	Parks	Access	Physical activity
148	United States	Grade 12	F	1506	Parks	Proximity	Physical activity
75	United States	Grade 7	M/F		Open spaces	Proximity	Physical activity

85	Norway	Grade 8	M/F	1347	Playground	Time spent	Physical activity
2	Netherlands	4-6, 7-9- and 10-12	M/F	6470	Gardens	Proximity	Physical activity
84	Norway	Secondary school and elementary school children	M/F	16471	Playgrounds	Time spent	Physical activity
152	United States	Grade 6-8	M/F	1370	Parks	Time spent and amenities	Physical activity
54	United States	Avg age 10.1	M/F	616	Parks	Use	Physical activity
96	United States	10-17	M/F	45392	Parks	Amount in neighbourhood	Physical activity
1	Netherlands	4-12 year olds	M/F	11, 094	Greenness	Amount in neighbourhood	Physical activity
31	Canada	0-5 year olds	M/F	800	Parks	Amount	Physical activity
167	New York	8 to 12	M/F	88	Park	Park percentage	Physical activity
47	Netherlands	6-11	M/F	422	Greenspace & water	Proportion	Physical Activity
170	United States	5-18	M/F	287 + 171	Park	Neighbourhood Environment score	Physical Activity
59	United States	Gr. 6	F	1554	Outdoors	Neighborhood factors	Physical activity
116	Cyprus	Middle school aged	M/F	676	Outdoors	Access & influence	Physical activity
134	Canada	9-14 years old	M/F	435	Parks	Neighbourhood proximity	Physical activity
41	United States	Preschool children	M/F	804 schools	Outdoors	Time use	Physical activity
46	United States	13-18 years old	M/F	2182	Wilderness	Time spent	BMI/Obesity
76	Germany	5-7 year old	M/F	810	Parks	Proximity	Physical activity
81		6-13 year olds	M/f	140	Outdoors	Time spent	Health
92	United States	Children and youth	M/F		Parks	Time spent	Physical activity
114	Canada	11-15 year old	M/F	6626	Parks	Time spent	Physical activity
119	United States	4-5 years old	M/F		Street trees	Proximity	Health
112	United States	Under 18	M/F	677	Parks	Time spent	Physical activity
100	United States	9-11 year olds	M./F	61	Landscape	Proximity	BMI/Obesity
124	Germany	Adolescents	M/F	1191	Green space	Proximity	Physical activity
175	Australia	6-7 year olds	M/F	4423	Neighbourhood green space	Proximity	BMI/Obesity

Table C2: Findings sorted by outcome/benefit

Physical Activity		
Article #	**Element of Nature**	**Findings**
117	Garden	Rural children more active in summer months, parents reported more space available in garden and in neighbourhood
36	Outside	Older children (10-12 year olds) who spent more time outdoors tended to be more active
14	Nature	Playground sports increased MVPA more than nature based orienteering
104	Parks	The primary finding of this study was that the proportion of time children are physically active was highest outdoors in the neighborhood or in public parks
34	Neighbourhood	Dog walkers walked in the neighborhood, played in the street and played in the yard more than non-dog walkers, but dog walking was not associated with overall PA
107	Parks	Less access to parks and rec was associated with lower MVPA
184	Parks	Safety from crime, higher aesthetics, better walking/cycling facilities and proximity to play area are associated with increased odds of park activity
137	School Playground	Higher levels of MVPA associated with open space, grass hill and cycling loop
43	Greenspace	Children were more likely to be active if parents perceived higher land use mix accessibility, lower street connectivity and more crime safety.
212	School playground	Play on the field leads to increases in MVPA, particularly in girls
66	Schoolyards	Increased physical activity in vegetated areas. Fixed play equipment associated with high levels of play.
5	School Playgrounds	The inclusion or omission of specific playground features may have an impact on the way that children use the spaces.
39	Parks	Renovated parks saw more than a doubling in the number of visitors and a substantial increase in energy expended in the parks.
166	Playgrounds	Activity intensity for both children and adults was greater when seating was not accessible.
160	Parks	Most often children and teens were observed engaging in vigorous activities in parks. Demographic groups showed patterns of physical activity within each group.
111	Parks	Younger children (0-12 years old) and African American children were observed in an active state more often than other groups of youth. PA was highest at trail/multi-use zones.
51	School playgrounds	Green areas encourage the highest percentage of children to be engaged in moderate PA.
198	Parks	The intervention resulted in a change in the amount of vigorously active taking place.
121	School playgrounds	Green areas attracted more students on average versus other areas.
95	Parks	Demographic differences evident in parks, results showed an equal number males and females using parks but a majority of users were adult or children
82	Neighborhood parks	Children were the most active subgroup in the parks. Neighbourhood parks play a significant role in supporting MVPA.
21	Parks and playgrounds	Activity levels were similar across boys and girls. Presence of other active children in a park area have positive associations.
15	Green spaces	Findings indicate that while a substantial proportion of time is allocated for PA, most children are not physically active during this time. Water based activities were associated with an increase in vigorous physical activity of both boys and girls

159	Parks	Recreational facilities are associated with physical activity, while no environmental neighborhood variables were related to changes in physical activity.
17	Parks	Trails and playgrounds are associated with higher activity levels for children and teens.
188	Green spaces	More play occurs in high vegetation spaces.
155	School playgrounds	Main themes influencing PA during break time are physical environment, social environment and individual environment
103	Parks	After construction of park zones, there was a significant decrease in energy expended in non-park areas and 3-fold increase in energy expended within the park boundaries.
138	Neighborhood parks	Availability of parks and recreational facilities in school residential neighborhoods was not associated with physical activity in school aged youth.
178	Seasons	Differences in the amount of physical activity between seasons may result from higher levels of activity due to the increased availability of outdoor recreational facilities and weather that supports activity behaviours.
18	Outdoors	For physically active pursuits during the week, locations outside the house are important. Gender and age influences report of physical activity while outside. Environmental factors can both facilitate and inhibit both active or sedentary behaviour
55	Parks	High park use for physical activity by adolescents was associated with the presence of 7 park features: lighting around court and amenities, a skate park, walking paths, BBQs, picnic tables, public access toilets and a high number of trees.
69	Schoolyards	The schoolyards provided different space and qualities of outdoor environments, but those factors did not seem to affect the physical activity level of the children in general.
162	Parks	Parks are not the main choice for adolescents in Brazil, who wish to be physically active
50	School yard	Green school yards encourage more active play Natural element encourage PA on school ground
127	Greenery	Greenery was found important by contributing to settings attractive to visit for girls as well as boys and for younger as well as older children, if located in ways that also supported peer interaction and various games
82	Park	Neighbourhood parks in LA play a significant role in serving local residents and supporting MVPA in particular Vigorous PA and half the time children spend in a park is MVPA.
91	Greenspace	Proportion of neighbourhood land covered by treed areas was positively associated with the physical activity outcome.
79	Neighbourhood greenspace	Higher levels of neighbourhood greenness was associated with higher levels of outdoor playing time
80	Parks	Living closer to large public parks and public open space increased the likelihood of being active at these sites regardless of age.
23	Park	Living closer to parks was associated with MVPA
9	Parks	More access to parks increases physical activity levels
10	Parks	Having a park near the home and one that is deemed safe, will increase physical activity levels
7	Parks	Increased park density was related to decreases in BMI
206	School garden	A greater decrease of sedentary activity and increase in time spent in moderate physical activity for children in the garden program
30	Parks	Children living in neighbourhoods with a high number of parks more likely to engage in physical activity and active transportation

149	Parks	Having a park near the home leads to more engagement in leisure time physical activity
72	Open spaces	Open spaces are positively associated with walking and cycling trips
56	Parks and beaches	Proximity to parks and beaches increased likelihood of physical activity
130	Outdoor	Parents attitudes towards nature was related to the amount of time spent outdoors in nature
53	Parks	Perception of park safety increase chances of children being physically active in parks
42	Parks	Greater number of amenities in the park were associated with greater odds of youth being vigorously active
49	Parks	Park use increased when parks were closer to children's home and had greater vegetation density.
57	Parks	Greater access to parks was associated with greater physical activity
110	Outdoors	Time spent outdoors in nature activities was similar from year to year
158	Parks	2% of total day physical activity takes place at parks with playgrounds
190	Open spaces	On weekends, boys performance 25 more minutes of MVPA with each additional playground in their closest public open spaces
207	Greenspace	Activities done in greenspace are more intense compared to non-greenspaces, especially for boys. Physical activity is more likely to be moderate-vigorous in greenspace than non-greenspace
168	Parks	Greater neighbourhood park and recreation areas were associated with greater physical activity
4	School playground	An average of 4.1 minutes were spent in grass area The natural area had the second highest levels of sedentary time
146	Greenspace	Large playing fields and woodlands showed significantly higher percentage of MVPA during outdoor time compared to small playground area
163	Parks	Park use was strongly associated with physical activity
93	Greenspace	Living in a smart growth community was associated with an increase in MVPA.
40	Parks, playgrounds, neighbourhood greenness	Children are most likely to be active around their home, in yards, parks, and playgrounds. Using different locations leads to being more physically active
99	Gardens	Participation in a program involving gardening can increase physical activity relative to either watching TV or habitual activity at home
11	Parks	More intense physical activity is done on paved trails, while less intense is done in dirt, mud or wood chipped area
38	Parks	Living near parks can lead to being more physically active
139	Neighbourhood greenness	Girls: more physically active when living in neighbourhoods deemed as "open spaces" Boys: higher rates of sedentary times when living in neighbourhoods deemed "housing and facility dense" compared to "open spaces"
150	School yard	Boys spent most of their time being physically active in the field.
94	Land use mix	Spending time outside the home leads to being more physically active; gardens and street environments can play a role in physical activity
22	Vegetation	Environments with more vegetation had higher step counts/min compared to environments with little vegetation
29	School yard	The presence of vegetation in a school playground was not a predictor of physical activity
175	Greenspace	Greenspace is not a significant predict for girls PA Greenspace is associated with more PA for boys, however it becomes less strongly related as children grow older.
25	Open spaces	Public open space showed a positive impact on MVPA
109	Land use mix	Land use mix and the presence of street trees significantly increase the likelihood of active transportation for the journey to school from home

60	Greenspace	Children spent a greater percentage of time in non-green space compared to green space
131	Greenspace	No association between green space and MVPA
140	Parks	Boys living near retail stores with a high floor area ratio were more physically active- perhaps because they walk to the shops therefore their overall PA is higher Number of nearby rec facilities and parks correlated positively with girls' physical activity.
173	Parks	Frequency of park use was the only correlate for older females (grade 7-12). Environmental variables work through other variables - among boys in grade 4-6 use of recreation time could be related to the frequency they use a nearby park
193	Parks	Land use mix and percentage of park coverage were not significant factors influencing PA; perhaps park quality is more important than park size
156	Parks	Higher perceived availability of parks in neighbourhood led to more walking and cycling during leisure time for at least 30 minutes a day.
90	Trees	Negative correlation between light intensity PA and the number of trees and tree height
181	Physical activity	There were significant changes in students' rates of PA
195	Parks	More likely to engage in activity if they lived within walking distance of: a park, skateboard ramp, sports field, place to swing, gym or a bicycle track
189	Parks	Children who perceive having limited access to parks in their neighbourhoods were less likely to walk or cycle.
148	Parks	For Caucasian girls there was an increase in physical activity with an increase in number of parks.
75	Open space	Distance to the nearest open play area was inversely and significantly related to outdoor PA for boys.
85	Playground	Open fields, outdoor obstacle course and playground equipment were associated with participation in PA during recess
2	Gardens	Absence of a garden was positively associated with outdoor play in girls aged 4-6 but negatively associated to outdoor play among girls aged 7-9 years.
84	Playgrounds	Boys at secondary level: areas with a soccer field, playground equipment, sledding hill more likely to be physically active. A sledding hill was also associated with girls PA participation in secondary school
152	Parks	Higher quality fields and courts are important amenities to have in parks, especially for Latino adolescents. Being sedentary while at the parks was positively linked with being older.
54	Parks	Latino youth with foreign-born parents were also generally more likely to use parks and physical activity facilities
96	Parks	The presence of parks was not significantly associated with minimum PA
1	Greenness	The perceived presence of green was negatively associated with walking to school.
31	Parks	Physical environments, such as distance to closest park, recreational facilities, and yard space at home, had little influence on PA behaviour of young children
167	Parks	When combining the boys and girls into a single group total physical activity was correlated to street connectivity and percentage park area
47	Greenspace	Significantly positively associated with physical activity
170	Park	Neighbourhood environment score was related consistently to neighbourhood based activities of being active in a park, walking to a park
59	Outdoors	Neighborhood factors like outdoor access, walking trails and seeing people outdoors are associated with lower BMI and higher MV-MVPA

116	Outdoors	Children's school location and gender influence personal, social and environmental correlates of PA. Access to outdoor activities and use is more prevalent with boys.
134	Parks	Children from neighbourhood with greater access to parks with sports fields and higher multi-use path had significantly higher average daily MVPA
41	Outdoors	Outdoor space renovations (including gardens, lawn, flowers) increased physical activity
76	Parks	Living near parks/green space can add to the frequency of outdoor play
92	Parks	Location of area for play and recreation most important factor in determining how children use the parks
114	Parks	Neighbourhood parks and public green spaces were not associated with physical inactivity
24	Green space	playing regularly in neighbors' gardens, in fields and woods further than 500 m away from home were associated with more outdoor play
112	Parks	Most youth were active during their trips to state parks
118	Street trees	Children living in neighbourhoods with more street trees were more physically activity.
86	School gardens	Improved children's physical activity in after school settings
124	Green space	Higher NDVI was associated with 11% more MVPA and 10% more leisure MVPA in females; while negative associations were seen for males in rural area. In urban area, green space was linked to 3% higher leisure sedentary behaviour.
Motor Development & Skills		
Article #	**Element of Nature**	**Findings**
68	Natural environment	A significant relation between the diversity of the landscape and the affordance of play was indicated. Motor fitness tests showed a general tendency that the children using the forest as playscape performed better in motor skills than the children on the traditional playground.
Sedentary behaviour		
Article #	**Element of Nature**	**Findings**
8	Parks	For boys only, more frequent episodes of playing sport or visiting the park as a family were associated with smaller increases in sedentary time
197	Open spaces	Children who live near a public open space with a water feature spend less time in front of screens
Food Consumption		
Article #	**Element of Nature**	**Findings**
63	Home Garden	A home-gardening program significantly improved the vitamin A
Fruits and Vegetable Consumption		
Article #	**Element of Nature**	**Findings**
33	Community Gardens	Children who participated in a community gardening program increased the amount of fruits and vegetables they consumed
147	School Garden	School gardens as a component of nutrition education can increase fruit and vegetable knowledge and cause behavior change among children
132	Youth Gardens	Value of youth gardens in increasing fruit and vegetable consumption for children.
86	School Gardens	Incorporating gardening improved children's reported vegetable intake

181	School garden	Students increased vegetable preferences and nutrition knowledge levels
194	School gardens	No significant relationship between school gardens and increased fruits and vegetable intake
135	Gardens	School gardens can impact positively on primary-school students' willingness to taste vegetables and their vegetable taste ratings
Eating Behaviour		
Article #	**Element of Nature**	**Findings**
78	School Gardens	Garden can enhance healthful eating habits, but the link between the school meal program, the garden, and healthful eating habits is lacking.
113	School Garden	The garden program positively impacted youth fruit and vegetable consumption
194	School Gardens	The presence of a school garden was associated less frequent consumption of fast food by students
BMI/Obesity		
Article #	**Element of Nature**	**Findings**
201	Neighbourhood greenness	Less parks and lower perception of safety in neighbourhood is associated with higher BMI
32	Parks	Overweight was not related to nature PA facilities
3	Parks	Children with access to parks and facilities had decreased prevalence of obesity as compared to children without access
100	Landscape	Children living in a neighbourhood with larger sizes of urban forests and tree patches had lower BMI
120	Street trees	Neighbourhood street tree density was associated with lower obesity prevalence
211	Parks	Children with better access to park and recreational resources are less likely to experience significant increases in attained BMI
199	Parks and Playgrounds	Children in neighbourhoods with good access to playgrounds, parks and recreational facilities were reportedly more active and were less likely to be overweight or obese
37	Pocket parks	Pocket park use compared favorably in promoting moderate-to-vigorous physical activity associated with weight loss.
52	Greenspace	Results showed protective associations by green space on birth outcomes. Increasing green space and/or reducing urban space may reduce the risk of adverse birth outcomes such as LBW and SGA
58	Greenspace	Findings showed that household income was inversely related to BMI. Found evidence for two indirect paths between household income and BMI. One relationship operates successively through open green space and physical activity. The second operates through physical activity alone.
210	Parkland and forest	Parkland was negatively associated with achieving 30 min of PA all 7 days of the week and positively associated with obesity among 9th grade boys
88	Greenspace	No direct influence of neighbourhood characteristics on adiposity in young children
181	School gardens	There was significant changes in student’s weight status
33	Community Gardens	17% of obese or overweight children had improved their BMI classification and 100% of the children with a BMI classifications of normal had maintained that BMI classification

179	Parks/Playground	Higher odds of children being obese or overweight in neighbourhoods with unfavourable social conditions (no access to sidewalks, parks and recreation centres)
133	Park/Playground	Children who lived within walking distance of a park or playground in their neighbourhood were less likely to be overweight or obese compared to children without access
153	Park	In general, parks/green space at the community level was not associated with overweight/ obesity
180	Natural environment	Results suggests that school based environmental interventions may be effective in reducing obesity in adolescents
16	Greenness	Higher greenness was significantly associated with lower BMI
115	Vegetation	Increased neighbourhood vegetation was associated with decreased risk for overweight, but only for subjects residing in higher population density regions
203	Parks	The presence of parks was associated with a reduction in BMI
65	Parks/Playground	Adding a neighbourhood park/playground may reduce the obesity rates.
194	School gardens	School gardens were associated with lower BMI and lower prevalence of being overweight
176	Greenspace	Evidence of an inverse association between green space and childhood BMI
154	Parks	Results suggest that availability of certain park facilities may play a more important role in promoting physical activity and healthy weight status among children
183	Outdoors	Children attending centers where the majority of outdoor surfaces were natural were found to engage in less MVPA. Presence of vegetation was not significantly associated with outdoor activity.
46	Wilderness	Participants moved towards a healthier weights and healthier ratios
45	Greenspace	Lower BMI z-scores and lower relative prevalence of overweight/obesity were associated with residential surrounding greenness and residential proximity to forests
175	Neighbourhood greenspace	Boys living near green space increased BMI at a slower rate per year. The benefit of greenspace is more evident as children grow older.
27	Land use	Greater school walkability was associated with significantly lower mean BMI
118	Parks	Children living in neighbourhoods with access to more parks had smaller skin folds than those living near fewer parks and trees
36	Outdoors	Older children (10-12 year olds) who spend more time outdoors had a lower prevalence of overweight than children spending less time outdoors
Health		
Article #	**Element of Nature**	**Findings**
101	Greenery	Having larger and more trees/forest areas around their homes were likely to have higher health related quality of life
81	Outdoors	Being outdoors in nature was negatively correlated with health problems (e.g., nasal congestion, asthma, trouble sleeping)
108	Neighbourhood Greenness	Greenness around a child's home increase the probability of being healthy
119	Street Trees	Higher street tree density was associated with a lower prevalence of childhood asthma

Table C3: Findings sorted by exposure of nature

Parks		
Article #	**Outcome/Benefit**	**Findings**
162	Physical activity	Parks are not the main choice for adolescents in Brazil, who wish to be physically active
8	Sedentary behaviour	For boys only, more frequent episodes of playing sport or visiting the park as a family were associated with smaller increases in sedentary time
104	Physical activity	The primary finding of this study was that the proportion of time children are physically active was highest outdoors in the neighborhood or in public parks
107	Physical activity	Less access to parks and rec was associated with lower MVPA
184	Physical activity	Safety from crime, higher aesthetics, better walking/cycling facilities and proximity to play area are associated with increased odds of park activity
39	Physical activity	Renovated parks saw more than a doubling in the number of visitors and a substantial increase in energy expended in the parks.
160	Physical activity	Most often children and teens were observed engaging in vigorous activities in parks. Demographic groups showed patterns of physical activity within each group.
30	Physical activity	Children living in neighbourhoods with a high number of parks more likely to engage in physical activity and active transportation
111	Physical activity	Younger children (0-12 years old) and African American children were observed in an active state more often than other groups of youth. PA was highest at trail/multi-use zones.
198	Physical activity	The intervention resulted in a change in the amount of vigorously active taking place.
95	Physical activity	Demographic differences evident in parks, results showed an equal number males and females using parks but a majority of users were adult or children
82	Physical activity	Children were the most active subgroup in the parks. Neighbourhood parks play a significant role in supporting MVPA.
21	Physical activity	Activity levels were similar across boys and girls. Presence of other active children in a park area have positive associations.
159	Physical activity	Recreational facilities are associated with physical activity, while no environmental neighborhood variables were related to changes in physical activity.
199	BMI/Obesity	Children in neighbourhoods with good access to playgrounds, parks and recreational facilities were reportedly more active and were less likely to be overweight or obese
114	Physical activity	Neighbourhood parks and public green spaces were not associated with physical inactivity
17	Physical activity	Trails and playgrounds are associated with higher activity levels for children and teens.
103	Physical activity	After construction of park zones, there was a significant decrease in energy expended in non-park areas and 3-fold increase in energy expended within the park boundaries.
138	Physical activity	Availability of parks and recreational facilities in school residential neighborhoods was not associated with physical activity in school aged youth.
40	Physical activity	Children are most likely to be active around their home, in yards, parks, and playgrounds. Using different locations leads to being more physically active

55	Physical activity	High park use for physical activity by adolescents was associated with the presence of 7 park features: lighting around court and amenities, a skate park, walking paths, BBQs, picnic tables, public access toilets and a high number of trees.
57	Physical activity	Greater access to parks was associated with greater physical activity when sedentary behaviour was reduced.
37	BMI/Obesity	Pocket park use compared favorably in promoting moderate-to-vigorous physical activity associated with weight loss.
179	BMI/Obesity	Higher odds of children being obese or overweight in neighbourhoods with unfavourable social conditions (no access to sidewalks, parks and recreation centres)
133	BMI/Obesity	Children who lived within walking distance of a park or playground in their neighbourhood were less likely to be overweight or obese compared to children without access
153	BMI/Obesity	In general, parks/green space at the community level was not associated with overweight/ obesity
3	BMI/Obesity	Children with access to parks and facilities had decreased prevalence of obesity as compared to children without access
203	BMI/Obesity	The presence of parks was associated with a reduction in BMI
65	BMI/Obesity	Adding a neighbourhood park/playground may reduce the obesity rates.
82	Physical activity	Neighbourhood parks play a significant role in serving local residents and supporting MVPA in particular vigorous PA and half the time children spend in a park is MVPA.
211	BMI/Obesity	Children with better access to park and recreational resources are less likely to experience significant increases in attained BMI
154	BMI/Obesity	Results suggest that availability of certain park facilities may play a more important role in promoting physical activity and health weight status among children
32	Physical activity	Overweight was not related to natural physical activity facilities
80	Physical activity	Living closer to large public parks and public open space increased the likelihood of being active at these sites regardless of age.
23	Physical Activity	Living closer to parks was associated with MVPA
9	Physical activity	More access to parks increases physical activity levels
10	Physical activity	Having a park near the home and one that is deemed safe, will increase physical activity levels
7	BMI/Obesity	Increased park density was related to decreases in BMI
149	Physical activity	Having a park near the home leads to more engagement in leisure time physical activity
56	Physical activity	Proximity to parks and beaches increased likelihood of physical activity
53	Physical activity	Perception of park safety increase chances of children being physically active in parks
42	Physical activity	Greater number of amenities in the park were associated with greater odds of youth being vigorously active
49	Physical activity	Park use increased when parks were closer to children's home and had greater vegetation density.
158	Physical activity	2% of total day physical activity takes place at parks with playgrounds
168	Physical activity	Greater neighbourhood park and recreation areas were associated with greater physical activity
163	Physical activity	Park use was strongly associated with physical activity
11	Physical activity	More intense physical activity is done on paved trails, while less intense is done in dirt, mud or wood chipped area
38	Physical activity	Living near parks can lead to being more physically active

140	Physical activity	Boys living near retail stores with a high floor area ratio were more physically active- perhaps because they walk to the shops therefore their overall PA is higher Number of nearby rec facilities and parks correlated positively with girls' physical activity.
173	Physical activity	Frequency of park use was the only correlate for older females (grade 7-12). Environmental variables work through other variables - among boys in grade 4-6 use of recreation time could be related to the frequency they use a nearby park
193	Physical activity	Land use mix and percentage of park coverage were not significant factors influencing PA; perhaps park quality is more important than park size
156	Physical activity	Higher perceived availability of parks in neighbourhood led to more walking and cycling during leisure time for at least 30 minutes a day.
189	Physical activity	Children who perceive having limited access to parks in their neighbourhoods were less likely to walk or cycle.
195	Physical activity	More likely to engage in activity if they lived within walking distance of: a park, skateboard ramp, sports field, place to swing, gym or a bicycle track
148	Physical activity	For Caucasian girls increase in physical activity associated with an increase in number of parks
152	Physical activity	Higher quality fields and courts in the park are important amenities to have in the park, especially for Latino adolescents. Being sedentary while at the parks was positively associated with being older.
96	Physical activity	The presence of parks was not significantly associated with physical activity
54	Physical activity	Latino youth with foreign-born parents were generally more likely to use parks and physical activity facilities
31	Physical activity	Distance to closest park, recreational facilities, and yard space at home, had little influence on PA behaviour of young children
167	Physical activity	When combining the boys and girls into a single group total physical activity was correlated to street connectivity and percentage park area
170	Physical activity	Neighbourhood environment score was related consistently to neighbourhood based activities of being active in a park, walking to a park
134	Physical activity	Neighbourhoods with greater access to parks with sports fields and higher multi-use path led to significantly higher average daily MVPA
76	Physical activity	Living near parks/green space can add to the frequency of outdoor play
92	Physical activity	Location of area for play and recreation is the most important factor in shaping how children use the parks
210	Physical activity	Parkland was negatively associated with achieving 30 min of PA all 7 days of the week and positively associated with obesity among 9th grade boys
112	Physical activity	Most youth were active during their trips to state parks
118	BMI/Obesity	Children living in neighbourhoods with access to more parks had smaller skin folds than those living near fewer parks and trees
School gardens		
Article #	**Outcome/Benefit**	**Findings**
132	Fruit and Vegetable Consumption	Value of youth gardens in increasing fruit and vegetable consumption for children.
86	Vegetable Consumption	Incorporating gardening improved children’s reported vegetable intake

86	Physical activity	Improved children's physical activity in after school settings
78	Eating behaviour	Data from the current and previous studies suggest that teachers and principals recognize that the garden can enhance healthful eating habits, but the link between the school meal program, the garden, and healthful eating habits is lacking.
147	Fruit and Vegetable Consumption	School gardens as a component of nutrition education can increase fruit and vegetable knowledge and cause behavior change among children
135	Fruits and vegetable consumption	School gardens can impact positively on primary-school students' willingness to taste vegetables and their vegetable taste ratings
194	Eating Behaviours	The presence of a school garden was associated less frequent consumption of fast food by students
194	Fruits and vegetable consumption	No significant relationship between school gardens and increased fruits and vegetable intake
206	Physical activity	A greater decrease of sedentary activity and increase in time spent in moderate physical activity for children in the garden program
194	BMI/Obesity	School gardens were associated with lower BMI and lower prevalence of being overweight
99	Physical activity	Participation in a program involving gardening can increase physical activity relative to either watching TV or habitual activity at home
2	Physical activity	Absence of a garden was positively associated with outdoor play in girls aged 4-6 but negatively associated to outdoor play among girls aged 7-9 years
181	Physical activity	There were significant changes in students' rates of PA
181	Vegetable Consumption	Students increased vegetable preferences and nutrition knowledge levels
181	BMI/Obesity	There was significant changes in student's weight status
113	Eating behaviour	The garden program positively impacted youth fruit and vegetable consumption
Community Gardens		
Article #	**Outcome/Benefit**	**Findings**
33	Fruit and Vegetable Consumption BMI/Obesity	Children who participated in a community gardening program increased the amount of fruits and vegetables they consumed
63	Food Consumption	A home-gardening program that was integrated with a primary health care activity, linked to nutrition education, and focused on the production of yellow and dark-green leafy vegetables significantly improved the vitamin A status of 2-5-y-old children in a rural village in South Africa
33	BMI/Obesity	17% of obese or overweight children had improved their BMI classification and 100% of the children with a BMI classifications of normal had maintained that BMI classification
117	Physical activity	Rural children more active in summer months, parents reported more space available in garden and in neighbourhood
Environmental Aspects		

Article #	Outcome/Benefit	Findings
180	BMI/Obesity	Results suggests that school based environmental interventions may be effective in reducing obesity in adolescents
100	BMI/Obesity	Children living in a neighbourhood with larger sizes of urban forests and tree patches had lower BMI
68	Motor development & skills	A significant relation between the diversity of the landscape and the affordance of play was indicated. Motor fitness tests showed a general tendency that the children using the forest as playscape performed better in motor skills than the children on the traditional playground.
Land use mix		
Article #	**Outcome/Benefit**	**Findings**
27	BMI/Obesity	Greater school walkability was associated with significantly lower mean BMI
109	Physical activity	Land use mix and the presence of street trees significantly increase the likelihood of active transportation for the journey to school from home
94	Physical activity	Spending time outside the home leads to being more physically active; gardens and street environments can play a role in physical activity
School yard		
Article #	**Outcome/Benefit**	**Findings**
50	Physical Activity	Green school yards encourage more active play Natural element encourage PA on school ground
4	Physical activity	An average of 4.1 minutes were spent in grass area The natural area had the second highest levels of sedentary time
150	Physical activity	Boys spent most of their time being physically active in the field.
29	Physical activity	The presence of vegetation in a school playground was not a predictor of physical activity
66	Physical activity	Increased physical activity in vegetated areas. Fixed play equipment associated with high levels of play.
137	Physical activity	Higher levels of MVPA associated with open space, grass hill and cycling loop
5	Physical activity	The inclusion or omission of specific playground features may have an impact on the way that children use the spaces.
51	Physical activity	Green areas encourage the highest percentage of children to be engaged in moderate PA.
121	Physical activity	Green areas attracted more students on average versus other areas.
155	Physical activity	Main themes influencing PA during break time: physical environment, social environment and individual environment.
69	Physical activity	The schoolyards provided different space and qualities of outdoor environments, but those factors did not seem to affect the physical activity level of the children in general.
212	Physical activity	Play on the field leads to increases in MVPA, particularly in girls
Greenery/Greenspace		
Article #	**Outcome/Benefit**	**Findings**
127	Physical Activity	Greenery was found important by contributing to settings attractive to visit for girls as well as boys and for younger as well as older children, if located in ways that also supported peer interaction and various games
24	Physical activity	playing regularly in neighbors' gardens, in fields and woods further than 500 m away from home were associated with more outdoor play
91	Physical activity	Proportion of neighbourhood land covered by treed areas was positively associated with the physical activity outcome.
207	Physical activity	Activities done in greenspace are more intense compared to non-greenspaces, especially for boys. Physical activity is more likely to be moderate-vigorous in greenspace than non-greenspace

146	Physical activity	Large playing fields and woodlands showed significantly higher percentage of MVPA during outdoor time compared to small playground area
101	Health	Having larger and more trees/forest areas around their homes were likely to have higher health related quality of life
93	Physical activity	Living in a smart growth community was associated with an increase in MVPA.
175	Physical activity	Greenspace is not a significant predict for girls PA Greenspace is associated with more PA for boys, however it becomes less strongly related as children grow older.
60	Physical activity	Children spent a greater percentage of time in non-green space compared to green space
131	Physical activity	No association between green space and MVPA
1	Physical activity	The perceived presence of green was negatively associated with walking to school.
47	Physical Activity	Significantly associated with the proportion of green space and frequency of water
88	BMI/Obesity	No direct influence of neighbourhood characteristics on adiposity in young children
16	BMI/ Obesity	Higher greenness was significantly associated with lower BMI
176	BMI/ Obesity	Evidence of an inverse association between green space and childhood BMI
45	BMI/ Obesity	Lower BMI z-scores and lower relative prevalence of overweight/obesity were associated with residential surrounding greenness and residential proximity to forests
124	Physical activity	Higher NDVI was associated with 11% more MVPA and 10% more leisure MVPA in females; while negative associations were seen for males in rural area. In urban area, green space was linked to 3% higher leisure sedentary behaviour.
43	Physical activity	Children were more likely to be active if parents perceived higher land use mix accessibility, lower street connectivity and more crime safety.
15	Physical activity	Findings indicate that while a substantial proportion of time is allocated for PA, most children are not physically active during this time. Water based activities were associated with an increase in vigorous physical activity of both boys and girls
188	Physical activity	More play occurs in high vegetation spaces.
52	BMI/Obesity	Results showed protective associations by green space on birth outcomes. Increasing green space and/or reducing urban space may reduce the risk of adverse birth outcomes such as LBW and SGA
58	BMI/Obesity	Findings showed that household income was inversely related to BMI. Found evidence for two indirect paths between household income and BMI. One relationship operates successively through open green space and physical activity. The second operates through physical activity alone.
Neighbourhood Greenness		
Article #	**Outcome/benefit**	**Findings**
79	Physical activity	Higher levels of neighbourhood greenness was associated with higher levels of outdoor playing time
108	Health	Greenness around a child's home increase the probability of being healthy
139	Physical activity	Girls: more physically active when living in neighbourhoods deemed as "open spaces" Boys: higher rates of sedentary times when living in neighbourhoods deemed "housing and facility dense" compared to "open spaces"

201	BMI/Obesity	Less parks and lower perception of safety in neighbourhood is associated with higher BMI
175	BMI/Obesity	Boys living near green space increased BMI at a slower rate per year. The benefit of greenspace is more evident as children grow older.
34	Physical activity	Dog walkers walked in the neighborhood, played in the street and played in the yard more than non-dog walkers, but dog walking was not associated with overall PA
Open spaces		
Article #	**Outcome/benefit**	**Findings**
72	Physical activity	Open spaces are positively associated with walking and cycling trips
190	Physical activity	On weekends, boys performance 25 more minutes of MVPA with each additional playground in their closest public open spaces
197	Sedentary behaviour	Children who live near a public open space with a water feature spend less time in front of screens
25	Physical activity	Public open space showed a positive impact on MVPA
75	Physical activity	Distance to the nearest open play area was inversely and significantly related to outdoor PA for boys.
Vegetation		
Article #	**Outcome/Benefit**	**Findings**
22	Physical activity	Environments with more vegetation had higher step counts/min compared to environments with little vegetation
115	BMI/Obesity	Increased neighbourhood vegetation was associated with decreased risk for overweight, but only for subjects residing in higher population density regions
Seasons		
Article #	**Outcome/Benefit**	**Findings**
178	Physical activity	Differences in the amount of physical activity between seasons may result from higher levels of activity due to the increased availability of outdoor recreational facilities and weather that supports activity behaviours.
Trees		
Article #	**Outcome/Benefit**	**Findings**
90	Physical activity	Negative correlation between light intensity PA and the number of trees and tree height
119	Health	Higher street tree density was associated with a lower prevalence of childhood asthma
120	BMI/Obesity	Neighbourhood street tree density was associated with lower obesity prevalence
118	Physical activity	Children living in neighbourhoods with more street trees were more physically activity
Playgrounds		
Article #	**Outcome/Benefit**	**Findings**
85	Physical activity	Open fields, outdoor obstacle course and playground equipment were associated with participation in PA during recess
84	Physical activity	Boys at secondary level: areas with a soccer field, playground equipment, sledding hill more likely to be physically active. A sledding hill was also associated with girls PA participation in secondary school
166	Physical activity	Activity intensity for both children and adults was greater when seating was not accessible.

14	Physical activity	Playground sports increased MVPA more than nature based orienteering
Outdoors		
Article #	**Outcome/Benefit**	**Findings**
59	Physical Activity	Neighborhood factors like outdoor access, walking trails, and seeing people outdoors are associated with lower BMI and higher MV-MVPA
116	Physical activity	Children's school location and gender influence personal, social and environmental correlates of physical activity. Access to outdoor activities and use is more prevalent with boys.
41	Physical activity	Outdoor space renovations (including gardens, lawn, flowers) increased physical activity
81	Health	Being outdoors in nature was negatively correlated with health problems (e.g., nasal congestion, asthma, trouble sleeping)
110	Physical activity	Time spent outdoors in nature activities was similar from year to year
130	Physical activity	Parents attitudes towards nature was related to the amount of time spent outdoors in nature
36	Physical activity	Older children (10-12 year olds) who spent more time outdoors tended to be more active
36	BMI/Obesity	Older children (10-12 year olds) who spend more time outdoors had a lower prevalence of overweight than children spending less time outdoors
18	Physical activity	For physically active pursuits during the week, locations outside the house are important. Gender and age influences report of physical activity while outside. Environmental factors can both facilitate and inhibit both active or sedentary behaviour
183	Physical activity	Children attending centers where the majority of outdoor surfaces was natural were found to engage in less MVPA. Presence of vegetation was not significantly associated with outdoor activity,
Wilderness		
Article #	**Outcome/Benefit**	**Findings**
46	BMI/Obesity	Participants moved towards a healthier weights and healthier ratios

Appendix D: Summary of Findings related to Mental Health and Emotional Well-Being

Table D1: Summary of Article Characteristics

	Sample Characteristics				Study Characteristics		
Article #	**Location (Country)**	**Ages (years)**	**Sex**	**N**	**Element of Nature**	**Exposure Type**	**Outcome/Benefit**
6	Spain	7-10	M/F	2111	Green Space & Greenness	Time spent, residential surrounding and residential proximity	ADHD & SDQ
13	Lithuania	4-6	M/F	1468	City parks & greenness	Proximity to city parks & residential greenness	SDQ
87	United Kingdom	12-15	M/F	25	Outdoor camp		Sociability, Self Esteem
101	United States	9-11	M/F	92	Landscape spatial patterns	Vegetation density, access, parks	HRQOL
67	United States	12-15	M/F	68	Parks	Access	Stress
187	United States	7-12	M/F	96	Greenness & tree cover & grass	Residential surrounding& vegetation density	ADD/ADHD
28	United States	12-18	M/F	50	Horticultural program	Working in nature, gardening, landscaping	Self esteem
186	United States	5-18	M/F	421	Grass, Trees	Assessing play setting	ADHD
123	Australia	5-12	M/F		Outdoors	Nature based activities	Mental Health & Well-Being

161	United Kingdom	11-12	M/F	75	Park	Physical Activity in urban vs nature	Self Esteem
125	Germany	9.4-11.7	M/F	1932	Green space	Access	SDQ
97	Austria	13-15	M/F	133	Schoolyard	Greening schoolyard	Well-Being
89	Canada	11-16	M/F	17249	Natural public space (green & blue)	School surrounding	Emotional Well-Being
145	South Africa	Grade 10	M	76	Outdoor Adventure Education	Outdoor activities in remote settings	Emotional Intelligence
106	United States	5-18	M/F	452	Natural areas, park, farm, green space	Activities in green space	ADHD
35		13-18	M/F	100	Wilderness settings	Treatment Program	Clinical Syndromes & Psychological stressors & Behaviour
196	Netherlands	9-17	M/F	12	Natural setting	Natural vs Built outdoor settings	ADHD
205	United States	Mean age 9.2	M/F	337	Vegetation	Naturalness of residential setting	Stress & Psychological distress
157	Australia	15-24	M/F	5	Wilderness journey	The Outdoor Experience Program	Mental Health
164	Canada	12-18	M/F	73	Wilderness	OALE: rapids, portages, navigations, open water crossings, wilderness canoe	Resilience & Mental Well-Being &Self Esteem
169	Israel	15-18	M/F	94	Desert	Wilderness Therapy	Self Esteem
70	England	9 months, 3, 5, 7	M/F	6348	Green space	Amount of green space using GLUD	Emotional & Behavioural problems

61	United States	7-12	M/F	17	Park	Walking in park	ADHD
182	Sweden	3-5.9	M/F	169	Outdoor area, trees, shrubbery, hilly terrain	Vegetation density, total outdoor area	Well-Being
210	United Kingdom	7-9	M/F	25	Garden, environmental area, outdoor classroom, grass field	Playing in different environments	Self Esteem
165	United Kingdom	11	M/F	18	Forest Schools	Outdoor Education	Mood
14	England	8.84	M/F	52	Green field with trees	Types of playtime interventions	Self Esteem
172	United States	16-18	M/F	858	Outdoor therapy	Outdoor Behaviour Healthcare Program	Behaviour
83	United States	13-18	M/F	221	Backpacking, rafting	Wilderness Therapy	ADD/ADHD Mental Health
177	Australia	15-24	M/F	21	Outdoors	Outdoor Adventure Camp	Self Esteem
209	United States	10-15	F	87	Mountain biking	Dirt-Diva Adventure Program	Resilience

Table D2: Findings sorted by outcome/benefit

Mental Health		
Article #	**Element of Nature**	**Findings**
13	Residential Surrounding/Proximity to Greenness	Farther residential distance from city parks associated with worse mental health (lower maternal education group) More residential greenness associated with worse mental health (higher maternal education group)
35	Wilderness Therapy	Had positive significant effects on clinical syndromes scores (anxious feelings, depressive affect, suicidal tendency)
157	The Outdoor Experience Program	Improvements in capacity to self-manage symptoms of mental ill health/disorders
83	Wilderness Therapy	Improvement in mental health
Emotional Well-Being		
Article #	**Element of Nature**	**Findings**
97	Redesign of Schoolyard	Enhanced psychological well-being in experimental group
165	Forest School	Greater positive change on 4 emotional variables in the forest school than in the indoor school setting Greatest effect from forest school on emotions and poor behaviour
182	Quality of Outdoor Environment	High quality outdoor environment associated with better well-being Strong positive correlation between environmental quality and outdoor stay
196	Woods vs Town walk	Generally reported somewhat more positive feelings in the woods
83	Wilderness Therapy	Improvement in emotional problems showing the most significant improvement of measured outcomes
145	Outdoor Adventure Program	Increase in emotional intelligence sub skills Follow up some skills more long lasting
6	Green space play time & Proximity to Greenness	Statistically significant inverse association between green space playing time and emotional symptoms Not conclusive for proximity to green space
70	Neighbourhood Green Space	Neighbourhood green space has the potential to help children from poor families have better emotional health early in life
13	Residential Greenness	Not a significant predictor of emotional well-being
89	Surrounding School Greenness	Surrounding school greenness was not a significant predictor of emotional well-being Small relationship between green space and positive emotional well-being in small cities
Resilience		
Article #	**Element of Nature**	**Findings**
164	Outdoor Adventure Leadership	Successful in promoting/ having a positive impact on resilience over the short term
70	Neighbourhood Green Space	Poor children with a higher percentage of green space in their neighbourhood had better emotional resilience
209	Outdoor Adventure Program	Higher levels of resilience, one month follow up maintained Increases mastery and relatedness, decrease in emotional reactivity
178	Outdoor Adventure Program	Increase in mastery (improved self-efficacy and coping skills)
Self Esteem		
Article #	**Element of Nature**	**Findings**
14	Nature Based Orienteering	Led to improvements in self-esteem but no significant differences in change due to type of intervention

28	Horticulture Program	Increase in self-esteem scores from pre to post test
87	Outdoor Adventure Camp	No significant effects
123	Nature Based School Activities	Self Esteem was considered to be very positively affected or positively affected, with some disagreement by teachers and principals
161	Green Exercise	Did not create an additional improvement in self-esteem in comparison to control
169	Wilderness Program	Increase in self-esteem in the wilderness therapy group (experimental), this change was not significant compared to an alternative group in the residential program (control 1)
177	Outdoor Camp	Significant improvement in self-esteem in the experimental group but not in control group
210	School playing environment	No significant effect for change in self-esteem due to environment
Stress		
Article #	**Element of Nature**	**Findings**
205	Residential Greenness	Nature buffers adverse impacts of stressful life events
67	Access to Parks	Inverse association between perceived stress Total percentage of parks within 800m predicted further reductions in perceived stress
Behavioural Disorders		
Article #	**Element of Nature**	**Findings**
172	Outdoor Behavioural Healthcare Program	Reduction on all subscales both self-reported and parent (Oppositional Defiant Disorder, substance disorders, and depression disorders)
13	Residential Surrounding/Proximity to Greenness	More problems non significantly associated with further distance to city parks (lower maternal education group) Increased residential greenness associated with more problems (higher maternal education group)
HRQOL[a] & SDQ[b]		
Article #	**Element of Nature**	**Findings**
101	Vegetation Density	Children with larger/more trees and forest areas within half mile of home likely to have higher HRQOL Longer distances between tree patches positively associated with higher HRQOL
6	Green space play time & Residential Surrounding/Proximity to Greenness	Statistically significant inverse association between green space playing time and residential surrounding greenness with SDQ total difficulties Proximity to major green space results not conclusive
ADHD		
Article #	**Element of Nature**	**Findings**
6	Residential Surrounding/Proximity to Greenness	RSG inversely associated with ADHD/inattention symptom scores RPG not associated with ADHD indicators
187	Activities in green space	Higher attentional functioning after activities in green settings Greener play environment less severe symptoms
186	Green Settings	Mildest ADHD symptoms in open grass setting Mildest ADD symptoms in open grass & big trees and grass
106	Activities in green space	Green outdoor activities significantly reduced ADHD symptoms more than activities conducted in other settings, even when matched across settings
125	Urban Green Space	Larger distance statistically significant with increased risk of inattention and hyperactivity

196	Woods vs Town walk	Children had better concentration in wood setting versus town setting
70	Frequency to Park	Frequency with which the mother took child to park/playground significantly related to fewer hyperactivity problems
61	Park vs Urban walk	Children with ADHD concentrated better after the walk in the park than after the downtown or neighbourhood park
13	Residential Surrounding/Proximity to Greenness	Hyperactivity increased as children became further from parks (lower maternal education group) Statistically non-significant association of RSG and hyperactivity (higher maternal education group)

Table D3: Findings sorted by exposure of nature

Proximity to Green Space		
Article #	**Outcome/Benefit**	**Findings**
13	Mental Health	Farther residential distance from city parks associated with worse mental health (lower maternal education group)
6	Emotional Well-Being	Not conclusive for proximity to green space
89	Emotional Well-Being	Surrounding school greenness was not a significant predictor of emotional well-being Small relationship between green space and positive emotional well-being in small cities
13	Behavioural Disorders	More problems non significantly associated with further distance to city parks (lower maternal education group)
6	HRQOL & SDQ	Proximity to major green space results not conclusive
6	ADHD	RPG not associated with ADHD indicators
13	ADHD	Hyperactivity increased as children became further from parks (lower maternal education group)
Residential or School Surrounding Greenness		
Article #	**Outcome/Benefit**	**Findings**
13	Mental Health	More residential greenness associated with worse mental health (higher maternal education group)
70	Emotional Well-Being	Neighbourhood green space has the potential to help children from poor families have better emotional health early in life
13	Emotional Well-Being	Not a significant predictor of emotional well-being
70	Resilience	Poor children with a higher percentage of green space in their neighbourhood had better emotional resilience
13	Behavioural Disorders	Increased residential greenness associated with more problems (higher maternal education group)
6	ADHD	Statistically significant inverse association between residential surrounding greenness with SDQ total difficulties Statistically significant inverse association between
125	ADHD	Larger distance statistically significant with increased risk of inattention and hyperactivity
13	ADHD	Statistically non-significant association of RSG and hyperactivity (higher maternal education group)
186	ADHD	Mildest ADHD symptoms in open grass setting Mildest ADD symptoms in open grass & big trees and grass
205	Stress	Nature buffers adverse impacts of stressful life events
Time Spent in Nature		
Article #	**Outcome/Benefit**	**Findings**
6	Emotional Well-Being	Statistically significant inverse association between green space playing time and emotional symptoms
6	SDQ	Statistically significant inverse association between green space playing time with SDQ total difficulties
Access & Frequency to Parks		
Article #	**Outcome/Benefit**	**Findings**
67	Stress	Inverse association between perceived stress Total percentage of parks within 800m predicted further reductions in perceived stress

70	ADHD	Frequency with which the mother took child to park/playground significantly related to fewer hyperactivity problems
Density of Vegetation		
Article #	**Outcome/Benefit**	**Findings**
101	HRQOL	Children with larger/more trees and forest areas within half mile of home likely to have higher HRQOL Longer distances between tree patches positively associated with higher HRQOL
Green Activities		
Article #	**Outcome/Benefit**	**Findings**
61	ADHD	Children with ADHD concentrated better after the walk in the park than after the downtown or neighbourhood park
195	ADHD	Children had better concentration in wood setting versus town setting
161	Self Esteem	Did not create an additional improvement in self-esteem in comparison to control
195	Emotional Well-Being	Generally reported somewhat more positive feelings in the woods
106	ADHD	Green outdoor activities significantly reduced ADHD symptoms more than activities conducted in other settings, even when matched across settings
187	ADHD	Higher attentional functioning after activities in green settings Greener play environment less severe symptoms
Nature in Schools		
Article #	**Outcome/Benefit**	**Findings**
210	Self Esteem	No significant effect for change in self-esteem due to environment
123	Self Esteem	Self Esteem was considered to be very positively affected or positively affected, with some disagreement by teachers and principals
97	Emotional Well-Being	Enhanced psychological well-being in experimental group
165	Emotional Well-Being	Greater positive change on 4 emotional variables in the forest school than in the indoor school setting Greatest effect from forest school on emotions and poor behaviour
182	Emotional Well-Being	High quality outdoor environment associated with better well-being Strong positive correlation between environmental quality and outdoor stay
Outdoor Adventure Camps & Wilderness Therapy		
Article #	**Outcome/Benefit**	**Findings**
35	Mental Health	Had positive significant effects on clinical syndromes scores (anxious feelings, depressive affect, suicidal tendency)
157	Mental Health	Improvements in capacity to self-manage symptoms of mental ill health/disorders
83	Mental Health	Improvement in mental health
83	Emotional Well-Being	Improvement in emotional problems showing the most significant improvement of measured outcomes
145	Emotional Well-Being	Increase in emotional intelligence sub skills Follow up some skills more long lasting
209	Resilience	Higher levels of resilience, one month follow up maintained Increases mastery and relatedness, decrease in emotional reactivity

177	Resilience	Increase in mastery (improved self-efficacy and coping skills)
164	Resilience	Successful in promoting/ having a positive impact on resilience over the short term
87	Self Esteem	No significant effects
169	Self Esteem	Increase in self-esteem in the wilderness therapy group (experimental), this change was not significant compared to an alternative group in the residential program (control 1)
177	Self Esteem	Significant improvement in self-esteem in the experimental group but not in control group
172	Behavioural Disorders	Reduction on all subscales both self-reported and parent (Oppositional Defiant Disorder, substance disorders, and depression disorders)
Nature Based Programs		
Article #	**Outcome/Benefit**	**Findings**
14	Self Esteem	Nature Based Orienteering led to improvements but no significant differences in change due to type of intervention
28	Self Esteem	Horticulture Program led to an increase in scores from pre to post test

Appendix E: Summary of Findings related to Social and Cognitive Development

Table E1: Summary of Article Characteristics

	Sample Characteristics				**Study Characteristics**		
Article #	**Location (Country)**	**Ages (years)**	**Sex**	**N**	**Element of Nature**	**Exposure Type**	**Outcome/ Benefit**
12	Australia	8-11	M/F	550	Vegetation and Trees	Vegetation volume in school playground	Focus and Attentional Capacities
208	England	13 (mean age)	M/F	48	Outdoor adventure camp	Outdoor education program	Self-concept Relationships
142	Wales and England	3.2-5.5 5-9	M/F	24	Forest School	Time spent learning outdoors	Cognitive Function Self-Discipline
141	United States	14-19	M/F	55	Wilderness Program	Time spent in wilderness program	Self-Worth and Identity Complexity
61	United States	7-12	M/F	17	Park	Walking through a park	Self-Discipline
20	Australia	8-12	M/F	592	Garden	Involvement in a seed to table kitchen garden program	Academic Achievement/Performance Focus and Attentional Capacities Relationships
129	Wales	4-7	M/F	48	Outdoor Classroom	Involvement in outdoor classroom	Behaviour Focus and Attentional Capacities
125	Germany	9.4-11.7	M/F	1932	Greenspace	Distance to urban green space	Behaviour Relationships
126	Sweden	4.5-6.5	M/F	198	Outdoors	Time spent outdoors; sky view factor	Focus and Attentional Capacities Self-Discipline
13	Lithuania	4-6	M/F	1468	Parks and residential greenspace	Proximity to city parks and residential greenness	Behaviour Relationships

44	Spain	7-10	M/F	2593	Greenspace	Proximity	Memory
204	United States	7-12	M/F	17	Greenspace	Views of nature	Focus and Attentional Capacities
62	United States	7-12	M/F	169	Greenspace	Views of nature	Self-Discipline
144	Kenya	Youth	M/F	32	Wilderness Program/Adventure Camp	Involvement in 3-day or 10-day outdoor adventure education program	Self-Worth and Identity Complexity Relationships
77	United States	students k-12	M/F	4194	Garden	Whether or not a school has a garden	Academic Achievement/ Performance
48	Germany	10.03 (mean age)	M/F	298	Wilderness Program/Adventure Camp, Parks	Involvement in week long program in National park	Academic Performance/ Achievement
165	Scotland	11 (average age)	M/F	18	Forest School	Involvement in Forest School or not during study period	Cognitive Function
143	England, Wales	3.2-9	M/F	24	Forest School	Time spent learning outdoors	Cognitive Function Relationships
128	United States	High schoolers	M/F	137 schools	Vegetation and Trees	Views of nature	Academic Achievement/ Performance
196	The Netherlands	9-17	M/F	12	Wooded Area	Visits to a Wooded Area	Self-Discipline
64	Sweden	13	M/F	86	Outdoor classroom	Outdoor classroom once a week	Academic Achievement/Performance
71	England	11-16	M	38	Outdoor classroom	Involvement in outdoor education program one afternoon a week for six or seven weeks	Academic Achievement/Performance Behaviour
213	United States of America	8-9	M/F	6333	Vegetation and Trees	NDVI values	Academic Achievement/Performance
200	United States of America	Grades 2-8	M/F	598	Garden	Participation in garden activities	Relationships
171	Spain	15-18	M/F	63	Garden	Spending 16 hours per week in a greenhouse	Academic Achievement/Performance
87	United Kingdom	12-15	M/F	25	Outdoor camp	Time spent	Behaviour
177	Australia	15-24	M/F	21	Outdoor camp	Outdoor Adventure Camp	Behaviour

6	Spain	7-10	M/F	2111	Beaches Greenspace	Time spent, residential surrounding and residential proximity	Behaviour Relationships
70	England	9 months, 3, 5, 7	M/F	6348	Green space	Amount of green space using GLUD	Behaviour Relationships
35		13-18	M/F	100	Wilderness	Treatment Program	Behaviour
83	United States	13-18	M/F	221	Wilderness (backpacking, rafting)	Wilderness Therapy	Behaviour
102	South Korea	8-10	M/F	24	Garden	Horticulture therapy program, planting, cultivating, cooking	Behaviour
106	United States	5-18	M/F	452	Green space	Activities in green space	Behaviour

Table E2: Findings sorted by outcome/benefit

Memory		
Article #	**Element of Nature**	**Findings**
44	Greenspace	Exposure to greenspace was associated with an enhancement in memory
Academic Achievement/Performance		
Article #	**Element of Nature**	**Findings**
20	Garden	Participation in the school kitchen garden program led to improvements in school performance.
77	Garden	School gardens can be used for academic instructions, often for teaching science, environmental studies, and nutrition.
48	Wilderness Program/Adventure Camp	Direct contact with nature helps cognitive achievement
128	Trees and Vegetation	Classrooms and lunch cafeterias with large windows looking out onto nature positively impacted student's academic success.
64	Outdoor Classroom	Outdoor classroom involvement led to improved performance in mathematics when compared to children in a traditional classroom.
71	Outdoor Classroom	Found conflicting results with showing both positive and negative results surrounding academic performance
213	Vegetation and Trees	Higher exposure to greenness demonstrated better academic performance.
171	Garden	Participation in a school garden-based learning program resulted in a decrease in school failure and dropout rates.
Cognitive Function		
Article #	**Element of Nature**	**Findings**
142	Forest School	Forest schools can lead to improved social skills, motivation and concentration
165	Forest School	Forest school involvement positively influences children's cognitive function in terms of energy, stress, anger, and hedonic state.
143	Forest School	Attending a forest school can lead to helping the development of language and communication skills.
Behaviour		
Article #	**Element of Nature**	**Findings**
129	Outdoor Classroom	Outdoor classrooms provide a calming effect to students, allowing children to listen more and remain on task rather than exhibit disruptive behaviours.
125	Greenspace	Children living further away from green space, had more overall behavioural problems, than those living closer to green space
13	Parks/greenness	Pro-social behaviour increased with proximity to parks
87	Outdoor camp	No significant changes in sociability in children
177	Outdoor camp	No significant changes in social connectedness
6	Beaches/Greenspace	Regular beach attendance had an inverse association with pro-social behaviour
70	Greenspace	Access to gardens and parks leads to fewer conduct problems in children
35	Wilderness	Significant positive effect on maladaptive behaviour
83	Wilderness	Decreased behavioural problems

71	Outdoor classroom	Promoted positive behaviour in children with severe emotional and behavioural difficulties.
102	Garden	children participating in a school gardening program showed higher sociability in comparison to a control group without the program
106	Green space	Exposure to greenspace had positive effects on behaviours in children with ADHD.
Self-Concept		
Article #	**Element of Nature**	**Findings**
208	Outdoor adventure camp	Outdoor adventure camp significantly changed adolescent's self-concept
Self-Worth and Identity Complexity		
Article #	**Element of Nature**	**Findings**
144	Wilderness Program/Adventure Camp	Significant increase in self-efficacy
141	Wilderness Program	Involvement in wilderness program resulted in positive changes in children's self-worth, sense of purpose, and identity complex.
Relationships		
Article #	**Element of Nature**	**Findings**
20	Garden	Children who participated in the school kitchen garden program experienced strengthening in social connections within school.
144	Wilderness Program/Adventure Camp	Increased inter-group relations
208	Outdoor adventure camp	Involvement in an outdoor education program resulted in trust-building with other children, and group cohesion.
125	Greenspace	Living further away from parks and greenspace led to more peer problems
13	Parks	Children living further from parks or urban greenspaces experience more peer problems
143	Forest School	Attending a forest school increases a child's cooperative work with others.
200	Garden	Gardens have a positive effect on interpersonal relationships
6	Beaches and green space	Statistically significant inverse association between green space play time and beach attendance and peer relationship problems
70	Greenspace	Frequency of greenspace visitation was related to fewer peer problems
Focus and Attentional Capacities		
Article #	**Element of Nature**	**Findings**
20	Garden	Children who participated in the school kitchen garden program experienced improvements in attention.
12	Vegetation and Trees	The amount of vegetation contributed by trees, grassy spaces, and the like within schools was associated with children's reports of perceived restorativeness of the school's playground.
129	Outdoor Classroom	Outdoor classrooms allow children to remain on task and listen rather than exhibit poor concentration.
126	Outdoors	Green outdoor environments positively correlated to the attention of preschool children.

204	Greenspace	Children exposed to the least amount of natural environment made the biggest increase in the attentional skill after moving to a new area with more nature environment.
Self-Discipline		
Article #	**Element of Nature**	**Findings**
62	Greenspace	For girls, greenspace immediately outside the home is strongly linked with self-discipline. For boys, more distant greenspace may be important.
61	Park	A walk through a park resulted in better concentration in children with ADHD compared to walking downtown or in a neighbourhood.
196	Wooded Area	Children with ADD or ADHD concentrated better in wooded areas compared to in town.
142	Forest school	Children improved their concentration

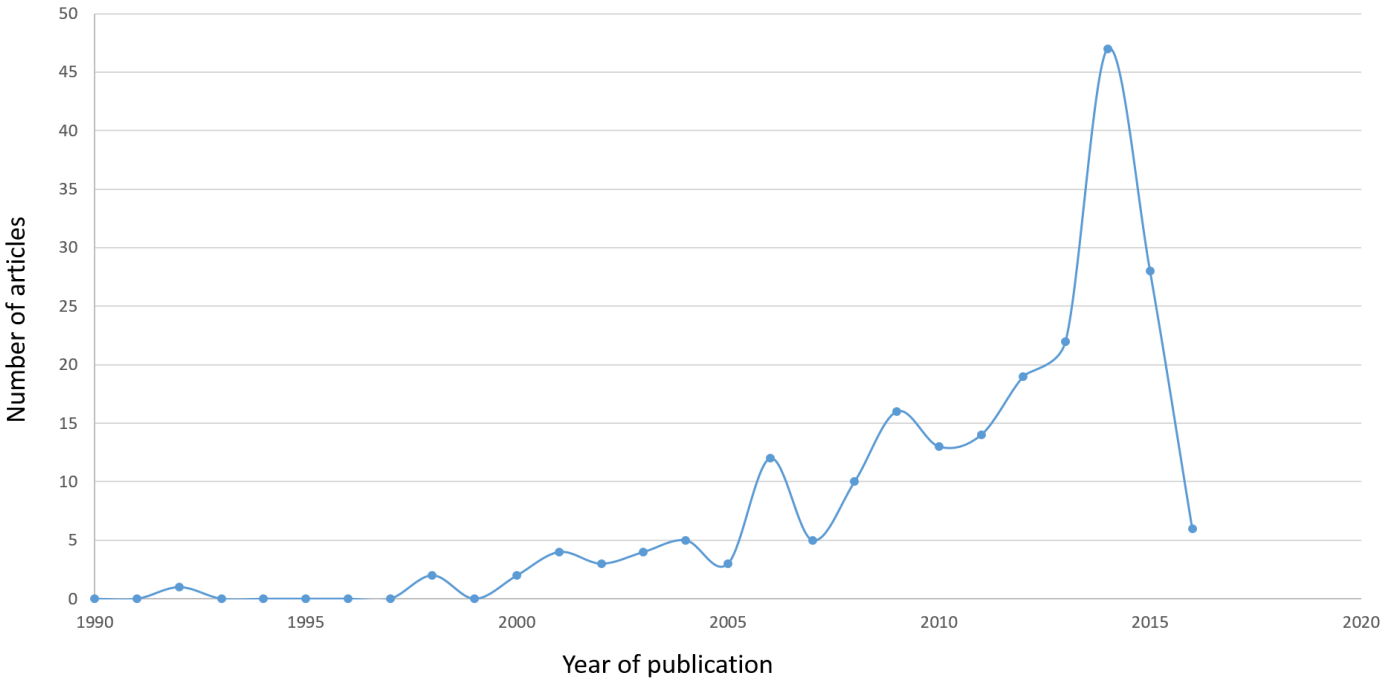
Table E3: Findings sorted by exposure of nature

Vegetation and Trees		
Article #	**Outcome/Benefit**	**Findings**
213	Academic Achievement/ Performance	Higher exposure to greenness demonstrated better academic performance.
12	Focus and Attentional Capacities	The amount of vegetation contributed by trees, grassy spaces, and the like within schools was associated with children's reports of perceived restorativeness of the school's playground.
128	Academic Achievement/ Performance	Direct contact with nature helps cognitive achievement
Outdoors		
Article #	**Outcome/Benefit**	**Findings**
126	Behaviour, Focus and Attentional Capacities	Green outdoor environments positively correlated to the behaviour, attention, and impulsivity of preschool children.
126	Self-Discipline	Green outdoor environments positively correlated to the behaviour, attention, and impulsivity of preschool children.
Forest School		
Article #	**Outcome/Benefit**	**Findings**
142	Cognitive Function	Forest school can lead to improved social skills, motivation and concentration
165	Cognitive Function	Forest school involvement positively influences children's cognitive function in terms of energy, stress, anger, and hedonic state.
142	Self-discipline	Children improved their concentration
143	Cognitive Function	Attending a forest school can lead to helping the development of language and communication skills, as well as increase children's self-esteem, confidence, and cooperative work with others.
143	Relationships	Attending a forest school increases a child's cooperative work with others.
Wilderness Program /Adventure Camp		
Article #	**Outcome/Benefit**	**Findings**
48	Academic Achievement/ Performance	Direct contact with nature helps cognitive achievement
144	Relationships	Increased inter-group relations
141	Self-Worth and Identity Complex	Involvement in 25-30 day wilderness program resulted in positive changes in children's self-worth, sense of purpose, and identity complex.
87	Behaviour	No significant changes in sociability in children
177	Behaviour	No significant changes in social connectedness
35	Behaviour	Significant positive effect on maladaptive behaviour
83	Behaviour	Decreased behavioural problems
208	Self-concept	Outdoor adventure camp significantly changed adolescent's self-concept
144	Self-Worth and Identity Complex	Significant increase in self-efficacy
208	Relationships	Involvement in an outdoor education program resulted in trust-building with other children, and group cohesion.
Park		
Article #	**Outcome/Benefit**	**Findings**
13	Behaviour	Pro-social behaviour increased with proximity to parks

61	Self-Discipline	Children with ADHD who walked through a park demonstrated enhanced attention and concentration compared to walking downtown or in a neighbourhood.
13	Relationships	Children living further from parks or urban greenspaces experience more peer problems
Gardens		
Article #	**Outcome/Benefit**	**Findings**
20	Academic Achievement/ Performance	Participation in the school kitchen garden program led to improvements in school performance.
20	Focus and Attentional Capacities	Children who participated in the school kitchen garden program experienced improvements in attention.
77	Academic Achievement/ Performance	School gardens can be used for academic instructions, often for teaching science, environmental studies, and nutrition.
20	Relationships	Children who participated in the school kitchen garden program experienced strengthening in social connections within school.
171	Academic Achievement/ Performance	Participation in a school garden-based learning program resulted in a decrease in school failure and dropout rates.
200	Relationships	Gardens have a positive effect on interpersonal relationships
102	Behaviour	children participating in a school gardening program showed higher sociability in comparison to a control group without the program
Outdoor classroom		
Article #	**Outcome/Benefit**	**Findings**
129	Behaviour	Outdoor classrooms provide a calming effect to students, allowing children to listen more and remain on task rather than exhibit disruptive behaviours.
64	Academic Achievement/ Performance	Outdoor classroom involvement led to improved performance in mathematics when compared to children in a traditional classroom.
71	Academic Achievement/ Performance	Found conflicting results with showing both positive and negative results
129	Focus and Attentional Capacities	Outdoor classrooms allow children to remain on task and listen rather than exhibit poor concentration.
71	Behaviour	Promoted positive behaviour in children with severe emotional and behavioural difficulties.
Wooded Area		
Article #	**Outcome/Benefit**	**Findings**
196	Self-Discipline	Children with ADD or ADHD concentrated and focused better in wooded areas compared to in town.
Greenspace		
Article #	**Outcome/Benefit**	**Findings**
204	Focus and Attentional Capacities	Children exposed to the least amount of natural environment made the biggest increase in the attentional skill after moving to a new area with more nature environment.
62	Self-Discipline	For girls, greenspace immediately outside the home is strongly linked with self-discipline. For boys, more distant greenspace may be important.
44	Memory	Exposure to greenspace was associated with an enhancement in memory
125	Relationships	Living further away from parks and greenspace led to more peer problems

125	Behaviour	Children living further away from green space, had more overall behavioural problems, than those living closer to green space
70	Behaviour	Access to gardens and parks leads to fewer conduct problems in children
6	Relationships	Statistically significant inverse association between green space play time and beach attendance and peer relationship problems
70	Relationship	Frequency of greenspace visitation was related to fewer peer problems
106	Behaviour	Exposure to greenspace had positive effects on behaviours in children with ADHD.
Beaches		
Article #	**Element of Nature**	**Findings**
6	Behaviour	Regular beach attendance has an inverse association with pro-social behaviour

Appendix F – Year of publications included in review



References

1.Aarts, M. J., Mathijssen, J. J. P., Van Oers, J. a M., & Schuit, A. J. (2013). Associations between environmental characteristics and active commuting to school among children: A cross-sectional study. *International Journal of Behavioral Medicine*, *20*, 538–555. http://doi.org/10.1007/s12529-012-9271-0

2.Aarts, M.-J., Wendel-Vos, W., van Oers, H. A. M., Van De Goor, I. A. M., & Schuit, A. J. (2010). Environmental determinants of outdoor play in children: a large-scale cross-sectional study. *American Journal of Preventive Medicine*, *39*(3), 212–219. http://doi.org/10.1016/j.amepre.2010.05.008

3.Alexander, D. S., Huber, L. R. B., Piper, C. R., & Tanner, A. E. (2013). The association between recreational parks, facilities and childhood obesity: a cross-sectional study of the 2007 National Survey of Children's Health. *Journal of Epidemiology and Community Health*, *67*, 427–431. http://doi.org/10.1136/jech-2012-201301

4.Andersen, H. B., Klinker, C. D., Toftager, M., Pawlowski, C. S., & Schipperijn, J. (2015). Objectively measured differences in physical activity in five types of schoolyard area. *Landscape and Urban Planning*, *134*, 83–92. http://doi.org/10.1016/j.landurbplan.2014.10.005

5.Anthamatten, P., Brink, L., Kingston, B., Kutchman, E., Lampe, S., & Nigg, C. (2014). An assessment of schoolyard features and behavior patterns in children's utilization and physical activity. *Journal of Physical Activity & Health*, *11*(3), 564–573. http://doi.org/10.1123/jpah.2012-0064

6.Amoly, E., Dadvand, P., Forns, J., López-Vicente, M., Basagaña, X., Julvez, J., … Sunyer, J. (2014). Green and blue spaces and behavioral development in Barcelona schoolchildren: the BREATHE project. *Environmental Health Perspectives*, *122*(12), 1351–1358. http://doi.org/10.1289/ehp.1408215

7.Armstrong, B., Lim, C. S., & Janicke, D. M. (2015). Park density impacts weight change in a behavioral intervention for overweight rural youth. *Behavioral Medicine*, *41*(3), 123–130. http://doi.org/10.1080/08964289.2015.1029428

8.Atkin, A. J., Corder, K., Ekelund, U., Wijndaele, K., Griffin, S. J., & van Sluijs, E. M. F. (2013). Determinants of change in children's sedentary time. *PLoS ONE*, *8*(6), e67627. http://doi.org/10.1371/journal.pone.0067627

9.Babey, S. H., Hastert, T. A., Yu, H., & Brown, E. R. (2008). Physical activity among adolescents. When do parks matter? *American Journal of Preventive Medicine*, *34*(4), 345–348. http://doi.org/10.1016/j.amepre.2008.01.020

10.Babey, S. H., Tan, D., Wolstein, J., & Diamant, A. L. (2015). Neighborhood, family and individual characteristics related to adolescent park-based physical activity. *Preventive Medicine*, *76*, 31–6. http://doi.org/10.1016/j.ypmed.2015.04.001

11.Baek, S., Raja, S., Park, J., Epstein, L. H., Yin, L., & Roemmich, J. N. (2015). Park design and children's active play: a microscale spatial analysis of intensity of play in Olmsted's Delaware Park. *Environment and Planning B: Planning and Design*, *42*, 1–19. http://doi.org/10.1177/0265813515599515

12.Bagot, K. L., Catherine, F., Allen, L., & Toukhsati, S. (2015). Perceived

restorativeness of children's school playground environments: Nature, playground features and play period experiences. *Journal of Environmental Psychology*, *41*, 1–9. http://doi.org/10.1016/j.jenvp.2014.11.005
13. Balseviciene, B., Sinkariova, L., Grazuleviciene, R., Andrusaityte, S., Uzdanaviciute, I., Dedele, A., & Nieuwenhuijsen, M. J. (2014). Impact of residential greenness on preschool children's emotional and behavioral problems. *International Journal of Environmental Research and Public Health*, *11*(7), 6757–6770. http://doi.org/10.3390/ijerph110706757
14. Barton, J., Sandercock, G., Pretty, J., & Wood, C. (2015). The effect of playground- and nature-based playtime interventions on physical activity and self-esteem in UK school children. *International Journal of Environmental Health Research*, *25*(2), 196–206. http://doi.org/10.1080/09603123.2014.915020
15. Beets, M. W., Weaver, R. G., Beighle, A., Webster, C., & Pate, R. R. (2013). How physically active are children attending summer day camps? *Journal of Physical Activity & Health*, *10*, 850–855. Retrieved from https://login.proxy.bib.uottawa.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=s3h&AN=90061411&site=ehost-live\n23070923\nhttps://login.proxy.bib.uottawa.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=s3h&AN=9060490
16. Bell, J. F., Wilson, J. S., & Liu, G. C. (2008). Neighborhood greenness and 2-year changes in body mass index of children and youth. *American Journal of Preventive Medicine*, *35*(6), 547–553. http://doi.org/10.1016/j.amepre.2008.07.006
17. Besenyi, G. M., Kaczynski, A. T., Wilhelm Stanis, S. A., & Vaughan, K. B. (2013). Demographic variations in observed energy expenditure across park activity areas. *Preventive Medicine*, *56*, 79–81. http://doi.org/10.1016/j.ypmed.2012.10.011
18. Biddle, S. J. H., Marshall, S. J., & Gorely, T. (2009). Temporal and environmental patterns of sedentary and active behaviors during adolescents ' leisure Ttme. *International Journal of Behavioral Medicine*, *16*, 278–286. http://doi.org/10.1007/s12529-008-9028-y
19. Blair, D. (2009). The child in the garden: An evaluative review of the benefits of school gardening. *The Journal of Environmental Education, 40*(2), 15-38. doi: 10.3200/JOEE.40.2.15-38
20. Block, K., Gibbs, L.,Staiger, P. K., Gold, L., Johnson, B, Macfarlane, S.,… &Townsend, M. (2012). Growing community: The impact of the stephanie alexander kitchen garden program on the social and learning environment in primary schools. *Health Education & Behavior*, *39*(4), 419–432. http://doi.org/10.1177/1090198111422937
21. Bocarro, J. N., Floyd, M. F., Smith, W. R., Edwards, M. B., Schultz, C. L., Baran, P., … Suau, L. J. (2015). Social and environmental factors related to boys' and girls' park-based physical activity. *Preventing Chronic Disease*, *12*, E97. http://doi.org/10.5888/pcd12.140532
22. Boldemann, C., Blennow, M., Dal, H., Mårtensson, F., Raustorp, A., Yuen, K., & Wester, U. (2006). Impact of preschool environment upon children's physical activity and sun exposure. *Preventive Medicine*, *42*, 301–308.

http://doi.org/10.1016/j.ypmed.2005.12.006
23. Boone-Heinonen, J., Casanova, K., Richardson, A. S., & Gordon-Larsen, P. (2010). Where can they play? Outdoor spaces and physical activity among adolescents in U.S. urbanized areas. *Preventive Medicine*, *51*, 295–298. http://doi.org/10.1016/j.ypmed.2010.07.013
24. Bringolf-Isler, B., Grize, L., Mäder, U., Ruch, N., Sennhauser, F. H., & Braun-Fahrländer, C. (2010). Built environment, parents' perception, and children's vigorous outdoor play. *Preventive Medicine*, *50*, 251–256. http://doi.org/10.1016/j.ypmed.2010.03.008
25. Buck, C., Tkaczick, T., Pitsiladis, Y., De Bourdehaudhuij, I., Reisch, L., Ahrens, W., & Pigeot, I. (2014). Objective measures of the built environment and physical activity in children: From walkability to moveability. *Journal of Urban Health: Bulletin of the New York Academy of Medicine*, *92*(1), 24–38. http://doi.org/10.1007/s11524-014-9915-2
26. Burdette, H. L., & Whitaker, R. C. (2005). Resurrecting free play in young children: looking beyond fitness and fatness to attention, affiliation, and affect. *Archives of pediatrics & adolescent medicine*, *159*(1), 46-50.
27. Burgoine, T., Jones, A. P., Namenek Brouwer, R. J., & Benjamin Neelon, S. E. (2015). Associations between BMI and home, school and route environmental exposures estimated using GPS and GIS: Do we see evidence of selective daily mobility bias in children? *International Journal of Health Geographics*, *14*(8), 1–12. http://doi.org/10.1186/1476-072X-14-8
28. Cammack, C., Waliczek, T. M., & Zajicek, J. M. (2002). The green brigade: The psychological effects of a community-based horticultural program on the self-development characteristics of juvenile offenders. *HortTechnology*, *12*(1), 82–86. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-0036141272&partnerID=tZOtx3y1
29. Cardon, G., Van Cauwenberghe, E., Labarque, V., Haerens, L., & De Bourdeaudhuij, I. (2008). The contribution of preschool playground factors in explaining children's physical activity during recess. *International Journal of Behavioral Nutrition and Physical Activity*, *5*(11). http://doi.org/10.1186/1479-Received
30. Carson, V., Kuhle, S., Spence, J. C., & Veugelers, P. J. (2010). Parents' perception of neighbourhood environment as a determinant of screen time, physical activity and active transport. *Canadian Journal of Public Health*, *101*(2), 124–127.
31. Carson, V., Rosu, A., & Janssen, I. (2014). A cross-sectional study of the environment, physical activity, and screen time among young children and their parents. *BMC Public Health*, *14*(61), 1–9. http://doi.org/10.1186/1471-2458-14-61
32. Casey, R., Chaix, B., Weber, C., Schweitzer, B., Charreire, H., Salze, P., … Simon, C. (2012). Spatial accessibility to physical activity facilities and to food outlets and overweight in French youth. *International Journal of Obesity*, *36*(10), 914–919. http://doi.org/10.1038/ijo.2012.10
33. Castro, D. C., Samuels, M., & Harman, A. E. (2013). Growing healthy kids: A community garden-based obesity prevention program. *American Journal of Preventive Medicine*, *44*(3), 193–199.

http://doi.org/10.1016/j.amepre.2012.11.024
34. Christian, H., Trapp, G., Villanueva, K., Zubrick, S. R., Koekemoer, R., & Giles-Corti, B. (2014). Dog walking is associated with more outdoor play and independent mobility for children. *Preventive Medicine*, *67*, 259–263. http://doi.org/10.1016/j.ypmed.2014.08.002
35. Clark, J. P. M., Marmol, L., Cooley, R., & Gathercoal, K. (2004). The effects of wilderness therapy on the clinical concerns (on Axes I, II and IV) of troubled Adolescents. *Journal of Experiential Education*, *27*(2), 213–232. Retrieved from https://www.lib.uwo.ca/cgi-bin/ezpauthn.cgi?url=http://search.proquest.com/docview/620252638?accountid=15115
36. Cleland, V., Crawford, D., Baur, L., Hume, C., Timperio, A. F., Salmon, J., … Salmon, J. (2008). A prospective examination of children's time spent outdoors, objectively measured physical activity and overweight. *International Journal of Obesity*, *32*, 1685–1693. http://doi.org/10.1038/ijo.2008.171
37. Cohen, D. a., Marsh, T., Williamson, S., Han, B., Derose, K. P., Golinelli, D., & McKenzie, T. L. (2014). The potential for pocket parks to increase physical activity. *American Journal of Health Promotion*, *28*(3), S19–S27. http://doi.org/10.4278/ajhp.130430-QUAN-213
38. Cohen, D. A., Scott Ashwood, J., Scott, M. M., Overton, A., Evenson, K. R., Staten, L. K., … Catellier, D. (2006). Public parks and physical activity among adolescent girls. *Pediatrics*, *118*(5), e1381–e1389. http://doi.org/10.1542/peds.2006-1226
39. Cohen, D., Han, B., Isacoff, J., Shulaker, B., Williamson, S., Marsh, T., … Bhatia, R. (2014). Impact of park renovations on park use and park-based physical activity. *Journal of Physical Activity and Health*, *12*, 289–295. http://doi.org/10.1123/jpah.2013-0165
40. Corder, K., Sallis, J. F., Crespo, N. C., & Elder, J. P. (2011). Active children use more locations for physical activity. *Health & Place*, *17*, 911–919. http://doi.org/10.1016/j.healthplace.2011.04.008
41. Cosco, N. G., Moore, R. C., & Smith, W. R. (2014). Childcare outdoor renovation as a built environment health promotion strategy: evaluating the preventing obesity by design intervention. *American Journal of Health Promotion*, *28*(3), S27–S32. http://doi.org/10.4278/ajhp.130430-QUAN-208
42. Coughenour, C., Coker, L., & Bungum, T. J. (2014). Environmental and social determinants of youth physical activity intensity levels at neighborhood parks in Las Vegas, NV. *Journal of Community Health*, *39*, 1092–1096. http://doi.org/10.1007/s10900-014-9856-4
43. D'Haese, S., Van Dyck, D., De Bourdeaudhuij, I., Deforche, B., & Cardon, G. (2015). The association between the parental perception of the physical neighborhood environment and children's location-specific physical activity. *BMC Public Health*, *15*(565), 1–9. http://doi.org/10.1186/s12889-015-1937-5
44. Dadvand, P., Nieuwenhuijsen, M.J., Esnaola, M., Forns, J., Basagana, X, Alvarez-Pedrerol, M.,… & Jerrett, M. (2015). Green space and cognitive development in primary schoolchildren. *Proceedings of the National Academy of Sciences, 112* (26), 7937-7942.

45. Dadvand, P., Villanueva, C. M., Font-Ribera, L., Martinez, D., Basagana, X., Belmonte, J., … Nieuwenhuijsen, M. J. (2014). Risks and benefits of green spaces for children: A cross-sectional study of associations with sedentary behavior, obesity, asthma, and allergy. *Environmental Health Perspectives*, *122*(12), 1329–1335. http://doi.org/10.1289/ehp.1308038
46. Demille, S. M., Comart, C., & Tucker, A. (2015). Body composition changes in an outdoor behavioral healthcare program. *Ecopsychology*, *6*(3), 174–182. http://doi.org/10.1089/eco.2014.0012
47. De vries, S.I., Bakker, I., van Mechelen, W., Hopman-Rock, M. (2007). Determinants of activity-friendly neighbourhoods for children: results from the SPACE study. *American Journal of Health Promotion, 21* (4S), 312-316.
48. Dieser, O., & Bogner, F. X. (2015). Young people's cognitive achievement as fostered by hands-on-centred environmental education. *Environmental Education Research*, 1–15. http://doi.org/10.1080/13504622.2015.1054265
49. Dunton, G. F., Almanza, E., Jerrett, M., Wolch, J., & Pentz, M. A. (2014). Neighborhood park use by children: use of accelerometry and global positioning systems. *American Journal of Preventive Medicine*, *46*(2), 136–142. http://doi.org/10.1016/j.amepre.2013.10.009
50. Dyment, J. E., & Bell, A. C. (2007). Active by design: Promoting physical activity through school ground greening. *Children's Geographies*, *5*(4), 463–477. http://doi.org/10.1080/14733280701631965
51. Dyment, J. E., Bell, A. C., & Lucas, A. J. (2009). The relationship between school ground design and intensity of physical activity. *Children's Geographies*, *7*(3), 261–276. http://doi.org/10.1080/14733280903024423
52. Ebisu, K., Holford, T. R., & Bell, M. L. (2016). Association between greenness, urbanicity, and birth weight. *Science of the Total Environment*, *542*, 750–756. http://doi.org/10.1016/j.scitotenv.2015.10.111
53. Echeverria, S. E., Kang, A. L., Isasi, C. R., Johnson-Dias, J., & Pacquiao, D. (2014). A community survey on neighborhood violence, park use, and physical activity among urban youth. *Journal of Physical Activity & Health*, *11*, 186–194. http://doi.org/10.1123/jpah.2012-0023
54. Echeverría, S. E., Ohri-Vachaspati, P., & Yedidia, M. J. (2015). The influence of parental nativity, neighborhood disadvantage and the built environment on physical activity behaviors in latino youth. *Journal of Immigrant Minority Health*, *17*, 519–526. http://doi.org/10.1007/s10903-013-9931-4
55. Edwards, N., Hooper, P., Knuiman, M., Foster, S., & Giles-Corti, B. (2015). Associations between park features and adolescent park use for physical activity. *International Journal of Behavioral Nutrition and Physical Activity*, *12*(21), 1–10. http://doi.org/10.1186/s12966-015-0178-4
56. Edwards, N. J., Giles-Corti, B., Larson, A., & Beesley, B. (2014). The effect of proximity on park and beach use and physical activity among rural adolescents. *Journal of Physical Activity and Health*, *11*, 977–984.
57. Epstein, L. H., Raja, S., Gold, S. S., Paluch, R. a, Pak, Y., & Roemmich, J. N. (2006). Reducing sedentary behavior. *Psychological Science*, *17*(8), 654–659. http://doi.org/10.1111/j.1467-9280.2006.01761.x
58. Evans, G. W., Jones-Rounds, M. L., Belojevic, G., & Vermeylen, F. (2012).

Family income and childhood obesity in eight European cities: the mediating roles of neighborhood characteristics and physical activity. *Social Science & Medicine*, *75*, 477–481. http://doi.org/10.1016/j.socscimed.2012.03.037
59. Evenson, K.R., Scott, M.M., Cohen, D.A., & Voohees, C.C. (2007). Girls' perception of neighbourhood factors on physical activity, sedentary behaviour, and BMI. *Obesity, 15*(2), 430-445.
60. Eyre, J., Duncan, M. J., Birch, S. L., Cox, V., & Blackett, M. (2015). Physical activity patterns of ethnic children from low socio-economic environments within the UK. *Journal of Sports Sciences*, *33*(3), 232–242. http://doi.org/10.1080/02640414.2014.934706
61. Faber, A., Frances, T., & Kuo, E. (2009). Children with attention deficits concentrate better after walk in the park. *Journal of Attention Disorders*, *12*(5), 402–409. http://doi.org/10.1177/1087054708323000
62. Faber Taylor, A., Kuo, F. E., & Sullivan, W. C. (2002). Views of nature and self-discipline: Evidence from inner city children. *Journal of Environmental Psychology*, *22*, 49–63. http://doi.org/10.1006/jevp.2001.0241
63. Faber, M., Phungula, M. A. S., Venter, S. L., Dhansay, M. A., & Spinnler Benadé, A. J. (2002). Home gardens focusing on the production of yellow and dark-green leafy vegetables increase the serum retinol concentrations of 2-5-y-old children in South Africa. *American Journal of Clinical Nutrition*, *76*(5), 1048–1054. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-0036829758&partnerID=tZOtx3y1
64. Fagerstam, E., & Samuelsson, J. (2014). Learning arithmetic outdoors in junior high school – influence on performance and self-regulating skills. *Education 3-13*, *42*(4), 419–431. http://doi.org/10.1080/03004279.2012.713374
65. Fan, M., & Jin, Y. (2013). Do neighbourhood parks and playgrounds reduce childhood obesity? *American Journal of Agricultural Economics, aat047.*
66. Farley, T. A., Meriwether, R. A., Baker, E. T., Rice, J. C., & Webber, L. S. (2008). Where do the children play? The influence of playground equipment on physical activity of children in free play. *Journal of Physical Activity and Health*, *5*, 319–331. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-46049119498&partnerID=tZOtx3y1
67. Feda, D. M., Seelbinder, A., Baek, S., Raja, S., Yin, L., & Roemmich, J. N. (2015). Neighbourhood parks and reduction in stress among adolescents: Results from Buffalo, New York. *Indoor and Built Environment*, *24*(5), 631–639. http://doi.org/10.1177/1420326X14535791
68. Fjørtoft, I. (2001). The natural environment as a playground for children: The impact of outdoor play activities in pre-primary school children. *Early Childhood Education Journal*, *29*(2), 111–117.
69. Fjørtoft, I., Kristoffersen, B. B., & Sageie, J. (2009). Children in schoolyards: Tracking movement patterns and physical activity in schoolyards using global positioning system and heart rate monitoring. *Landscape and Urban Planning*, *93*, 210–217. http://doi.org/10.1016/j.landurbplan.2009.07.008
70. Flouri, E., Midouhas, E., & Joshi, H. (2014). The role of urban neighbourhood green space in children's emotional and behavioural resilience. *Journal of Environmental Psychology*, *40*, 179–186.

http://doi.org/10.1016/j.jenvp.2014.06.007
71. Fox, P., & Avramidis, E. (2003). An evaluation of an outdoor education programme for students with emotional and behavioural difficulties. *Emotional and Behavioural Difficulties*, *8*(4), 267–283. http://doi.org/10.1177/136327520384002
72. Ghekiere, A., Carver, A., Veitch, J., Salmon, J., Deforche, B., & Timperio, A. (2016). Does parental accompaniment when walking or cycling moderate the association between physical neighbourhood environment and active transport among 10–12 year olds? *Journal of Science and Medicine in Sport*, *19*, 149–153. http://doi.org/10.1016/j.jsams.2015.01.003
73. Gill, T. (2011) Children and nature: A quasi-systematic review of the empirical evidence. A report for the London sustainable development
74. Gilliland, J.A., Rangel, C. Y., Healy, M. A., Tucker, P., Loebach, J. E., Hess, P.M., et al. (2012). Linking childhood obesity to the built environment: A multi-level analysis of home and school neighbourhood factors associated with body mass index. *Canadian Journal of public health, 103,* S15-21.
75. Gomez, J.E., Johnson, B.A., Selva, M., & Sallis, J.F. (2004). Violent crime and outdoor physical activity among inner-city youth. *Preventive Medicine, 39* (5), 876-881.
76. Gose, M., Plachta-Danielzik, S., Willie, B., Johannsen, M., Landsberg, B., & Müller, M. J. (2013). Longitudinal influences of neighbourhood built and social environment on children's weight status. *International Journal of Environmental Research and Public Health*, *10*, 5083–5096. http://doi.org/10.3390/ijerph10105083
77. Graham, H., Beall, D. L., Lussier, M., Mclaughlin, P., & Zidenberg-Cherr, S. (2005). Use of school gardens in academic instruction. *Journal of Nutrition Education and Behavior*, *37*, 147–151.
78. Graham, H., & Zidenberg-Cherr, S. (2005). California teachers perceive school gardens as an effective nutritional tool to promote healthful eating habits. *Journal of the American Dietetic Association*, *105*(11), 1797–1800. http://doi.org/10.1016/j.jada.2005.08.034
79. Grigsby-Toussaint, D. S., Chi, S.-H., & Fiese, B. H. (2011). Where they live, how they play: neighborhood greenness and outdoor physical activity among preschoolers. *International Journal of Health Geographics*, *10*(66), 1–10. http://doi.org/10.1186/1476-072X-10-66
80. Grow, H. M., Saelens, B. E., Kerr, J., Durant, N. H., Norman, G. J., & Sallis, J. F. (2008). Where are youth active? Roles of proximity, active transport, and built environment. *Medicine and Science in Sports and Exercise*, *40*(12), 2071–2079. http://doi.org/10.1249/MSS.0b013e3181817baa
81. Hammond, D. E., Mcfarland, A. L., Zajicek, J. M., & Waliczek, T. M. (2011). Growing minds: The relationship between parental attitudes toward their child's outdoor recreation and their child's health. *HortTechnology*, *21*(2), 217–224. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-79955710370&partnerID=tZOtx3y1
82. Han, B., Cohen, D. A., Derose, K. P., Marsh, T., Williamson, S., & Raaen, L. (2014). How much neighborhood parks contribute to local residents' physical

activity in the City of Los Angeles: a meta-analysis. *Preventive Medicine*, *69*, S106–S110. http://doi.org/10.1016/j.ypmed.2014.08.033
83. Harper, N. J., Russell, K. C., Cooley, R., & Cupples, J. (2007). Catherine freer wilderness therapy expeditions: An exploratory case study of adolescent wilderness therapy, family functioning, and the maintenance of change. *Child and Youth Care Forum*, *36*(2-3), 111–129. http://doi.org/10.1007/s10566-007-9035-1
84. Haug, E., Torsheim, T., Sallis, J. F., & Samdal, O. (2010). The characteristics of the outdoor school environment associated with physical activity. *Health Education Research*, *25*(2), 248–256. http://doi.org/10.1093/her/cyn050
85. Haug, E., Torsheim, T., & Samdal, O. (2008). Physical environmental characteristics and individual interestes as correlates of physical activity in Norwegian secondary schools: the health behaviour in school-aged children study. *International Journal of Behavioural Nutrition and Physical Activity, 5*(1), 47.
86. Hermann, J. R., Parker, S. P., Brown, B. J., Siewe, Y. J., Denney, B. A., & Walker, S. J. (2006). After-school gardening improves children's reported vegetable intake and physical activity. *Journal of Nutrition Education and Behavior*, *38*, 201–202. http://doi.org/10.1016/j.jneb.2006.02.002
87. Hinds, J. (2011). Woodland adventure for marginalized adolescents: Environmental attitudes, identity and competence. *Applied Environmental Education & Communication*, *10*(4), 228–237. http://doi.org/10.1080/1533015X.2011.669689
88. Hrudey, E. J., Kunst, A. E., Stronks, K., & Vrijkotte, T. G. M. (2015). Do neighborhood characteristics in Amsterdam influence adiposity at preschool age? *International Journal of Environmental Research and Public Health*, *12*, 5561–5580. http://doi.org/10.3390/ijerph120505561
89. Huynh, Q., Craig, W., Janssen, I., & Pickett, W. (2013). Exposure to public natural space as a protective factor for emotional well-being among young people in Canada. *BMC Public Health*, *13*(407), 1–14. http://doi.org/10.1186/1471-2458-13-407
90. Jago, R., Baranowski, T., Zakeri, I., & Harris, M. (2005). Observed environmental features and the physical activity of adolescent males. *American Journal of Preventive Medicine, 29*(2), 98-104.
91. Janssen, I., & Rosu, A. (2015). Undeveloped green space and free-time physical activity in 11 to 13-year-old children. *International Journal of Behavioral Nutrition and Physical Activity*, *12*(26), 1–7. http://doi.org/10.1186/s12966-015-0187-3
92. Jenkins, G. R., Yuen, H. K., Rose, E. J., Maher, A. I., Gregory, K. C., & Cotton, M. E. (2015). Disparities in Quality of Park Play Spaces between Two Cities with Diverse Income and Race/Ethnicity Composition: A Pilot Study. *International Journal of Environmental Research and Public Health*, *12*, 8009–8022. http://doi.org/10.3390/ijerph120708009
93. Jerrett, M., Almanza, E., Davies, M., Wolch, J., Dunton, G., Spruitj-Metz, D., & Ann Pentz, M. (2013). Smart growth community design and physical activity in children. *American Journal of Preventive Medicine*, *45*(4), 386–392. http://doi.org/10.1016/j.amepre.2013.05.010
94. Jones, A. P., Coombes, E. G., Griffin, S. J., & Mf Van Sluijs, E. (2009).

Environmental supportiveness for physical activity in English schoolchildren: A study using global positioning systems. *International Journal of Behavioral Nutrition and Physical Activity*, *6*(42), 1–8. http://doi.org/10.1186/1479-5868-6-42
95. Kaczynski, A. T., Stanis, S. A. W., Hastmann, T. J., & Besenyi, G. M. (2011). Variations in observed park physical activity intensity level by gender, race, and age: Individual and joint effects. *Journal of Physical Activity and Health*, *8*(2), S151–S160. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84856207070&partnerID=tZOtx3y1
96. Kasehagen, L., Busacker, A., Kane, D., & Rohan, A. (2012). Associations between neighborhood characteristics and physical activity among youth within rural–urban commuting areas in the US. *Maternal and Child Health Journal*, *16*, S258–S267. http://doi.org/10.1007/s10995-012-1188-3
97. Kelz, C., Evans, G. W., & Röderer, K. (2015). The restorative effects of redesigning the schoolyard: A multi-methodological, quasi-experimental study in rural austrian middle schools. *Environment and Be*
98. Kellert, S. R. (2002). Experiencing Nature: Affective, Cognitive, and evaluative Development in Children. In P. H. Kahn & S. R. Kellert (Eds.), *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations* (pp. 117–172). Cambridge MA: The MIT Press. Retrieved from https://books.google.ca/books?hl=en&lr=&id=RCjdKjI_qIcC&oi=fnd&pg=PA117&dq=experiecing+nature:+affective+cognitive+and+evaluative+development+in+children&ots=S9WAg9Vc1r&sig=mBzsRBsxtynQ3gVvtEaFrY2h2Zw#v=onepage&q=experiecing nature: affective cognitive
99. Kien, C. L., & Chiodo, A. R. (2003). Physical activity in middle school-aged children participating in a school-based recreation program. *Archives of Pediatrics & Adolescent Medicine*, *157*, 811–815. http://doi.org/10.1001/archpedi.157.8.811
100. Kim, J.-H., Lee, C., Olvera, N. E., & Ellis, C. D. (2014). The role of landscape spatial patterns on obesity in hispanic children residing in inner-city neighborhoods. *Journal of Physical Activity and Health*, *11*, 1449–1457. http://doi.org/10.1123/jpah.2012-0503
101. Kim, J.-H., Lee, C., & Sohn, W. (2016). Urban natural environments, obesity, and health-related quality of life among hispanic children living in inner-city neighborhoods. *International Journal of Environmental Research and Public Health*, *13*(121), 1–15. http://doi.org/10.3390/ijerph13010121
102. Kim, B. Y., Park, S. A., Song, J. E., & Son, K. C. (2012). Horticultural therapy program for the improvement of attention and sociality in children with intellectual disabilities. *HortTechnology*, *22*(3), 320–324. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84863191941&partnerID=tZOtx3y1
103. King, D. K., Litt, J., Hale, J., Burniece, K. M., & Ross, C. (2015). “The park a tree built”: Evaluating how a park development project impacted where people play. *Urban Forestry & Urban Greening*, *14*, 293–299. http://doi.org/10.1016/j.ufug.2015.02.011
104. Kneeshaw-Price, S., Saelens, B. E., Sallis, J. F., Glanz, K., Frank, L. D., Kerr,

J., … Cain, K. L. (2013). Children's objective physical activity by location: Why the neighborhood matters. *Pediatric Exercise Science*, *25*, 468–486. http://doi.org/2012-0127 [pii]

105. Kochanowski, L. & Carr, V. (2014). Nature playscapes as contexts for fostering self-determination. *Children, youth & environments, 24* (2), 146-167. doi: 10.7721/chilyoutenvi.24.2.0146

106. Kuo, F. E., & Taylor, A. F. (2004). A potential natural treatment for attention-deficit/hyperactivity disorder: Evidence from a national study. *American Journal of Public Health*, *94*(9), 1580–1586. http://doi.org/10.2105/AJPH.94.9.1580

107. Kurka, J. M., Adams, M. A., Todd, M., Colburn, T., Sallis, J. F., Cain, K. L., … Saelens, B. E. (2015). Patterns of neighborhood environment attributes in relation to children's physical activity. *Health & Place*, *34*, 164–170. http://doi.org/10.1016/j.healthplace.2015.05.006

108. Kyttä, A. M., Broberg, A. K., & Kahila, M. H. (2012). Urban environment and children's active lifestyle: SoftGIS revealing children's behavioral patterns and meaningful places. *American Journal of Health Promotion*, *26*(5), e137–e148. http://doi.org/10.4278/ajhp.100914-QUAN-310

109. Larsen, K., Gilliland, J., Hess, P., Tucker, P., Irwin, J., & He, M. (2009). The influence of the physical environment and sociodemographic characteristics on children's mode of travel to and from school. *American Journal of Public Health*, *99*(3), 520–526. http://doi.org/10.2105/AJPH.2008.135319

110. Larson, L. R., Green, G. T., & Cordell, H. K. (2011). Children's time outdoors: results and implications of the national kids survey. *Journal of Park and Recreation Administration*, *29*(2), 1–20.

111. Larson, L. R., Whiting, J. W., Green, G. T., & Bowker, J. M. (2014). Physical activity of youth in non-urban parks: an observation-based assessment. *Leisure/Loisir*, *38*(3-4), 225–232. http://doi.org/10.1080/14927713.2015.1042212

112. Larson, L. R., Whiting, J. W., Green, G. T., & Bowker, J. M. (2015). Contributions of non-urban state parks to youth physical activity: A case study in northern Georgia. *Journal of Park and Recreation Administration*, *33*(2), 20–36.

113. Lautenschlager, L., & Smith, C. (2007). Understanding gardening and dietary habits among youth garden program participants using the Theory of Planned Behavior. *Appetite*, *49*, 122–130. http://doi.org/10.1016/j.appet.2007.01.002

114. Laxer, R. E., & Janssen, I. (2013). The proportion of youths' physical inactivity attributable to neighbourhood built environment features. *International Journal of Health Geographics*, *12*(31), 1–13. http://doi.org/10.1186/1476-072X-12-31

115. Liu, G. C., Wilson, J. S., Qi, R., & Ying, J. (2007). Green neighborhoods, food retail and childhood overweight: Differences by population density. *American Journal of Health Promotion*, *21*(4 SUPPL.), 317–325. http://doi.org/hepr-21-00-06.3d

116. Loucaides, C.A. (2009). School location and gender differences in personal, social, and environmental correlates of physical activity in Cypriot middle school children. *Journal of Physical Activity and Health, 6* (6), 722.

117. Loucaides, C. A., Chedzoy, S. M., & Bennett, N. (2004). Differences in physical activity levels between urban and rural school children in Cyprus. *Health Education Research*, *19*(2), 138–147. http://doi.org/10.1093/her/cyg014

118. Lovasi, G. S., Jacobson, J. S., Quinn, J. W., Neckerman, K. M., Ashby-Thompson, M. N., & Rundle, A. (2011). Is the environment near home and school associated with physical activity and adiposity of urban preschool children? *Journal of Urban Health*, *88*(6), 1143–1157. http://doi.org/10.1007/s11524-011-9604-3
119. Lovasi, G. S., Quinn, J. W., Neckerman, K. M., Perzanowski, M. S., & Rundle, A. (2008). Children living in areas with more street trees have lower prevalence of asthma. *Journal of Epidemiology and Community Health*, *62*, 647–649. http://doi.org/10.1136/jech.2007.071894
120. Lovasi, G. S., Schwartz-Soicher, O., Quinn, J. W., Berger, D. K., Neckerman, K. M., Jaslow, R., … Rundle, A. (2013). Neighborhood safety and green space as predictors of obesity among preschool children from low-income families in New York City. *Preventive Medicine*, *57*, 189–193. http://doi.org/10.1016/j.ypmed.2013.05.012
121. Lucas, A. J., & Dyment, J. E. (2010). Where do children choose to play on the school ground? The influence of green design. *Education 3-13*, *38*(2), 177–189. http://doi.org/10.1080/03004270903130812
122. Maller, C. J. (2009). Promoting children's mental, emotional and social health through contact with nature: a model. *Health Education*, *109*(6), 522–543. http://doi.org/10.1108/09654280911001185
123. Maller, C., & Townsend, M. (2006). Children's mental health and wellbeing and hands-on contact with nature. *International Journal of Learning*, *12*(4), 359–372. Retrieved from http://dro.deakin.edu.au/view/DU:30003638
124. Markevych, I., Smith, M. P., Jochner, S., Standl, M., Brüske, I., von Berg, A., … Schulz, H. (2016). Neighbourhood and physical activity in German adolescents: GINIplus and LISAplus. *Environmental Research*, *147*, 284–293. http://doi.org/10.1016/j.envres.2016.02.023
125. Markevych, I., Tiesler, C.M.T., Fuertes, E., Romanos, M., Dadvand, P., Nieuwenhuijsen, M.J., …Heinrich, J. (2014). Access to urban green spaces and behavioural problems in children: Results from the GINIplus and LISAplus studies. *Environmental International, 71,*29-35. doi: org/10.1016/j.envint.2014.06.002
126. Mårtensson, F., Boldemann, C., Söderström, M., Blennow, M., Englund, J. E., & Grahn, P. (2009). Outdoor environmental assessment of attention promoting settings for preschool children. *Health and Place*, *15*, 1149–1157. http://doi.org/10.1016/j.healthplace.2009.07.002
127. Mårtensson, F., Jansson, M., Johansson, M., Raustorp, A., Kylin, M., & Boldemann, C. (2014). The role of greenery for physical activity play at school grounds. *Urban Forestry & Urban Greening*, *13*, 103–113. http://doi.org/10.1016/j.ufug.2013.10.003
128. Matsuoka, R. H. (2010). Student performance and high school landscapes: Examining the links. *Landscape and Urban Planning*, *97*, 273–282. http://doi.org/10.1016/j.landurbplan.2010.06.011
129. Maynard, T., Waters, J., & Clement, J. (2016). Child-initiated learning, the outdoor environment and the "underachieving" child. *Early Years*, *33*(3), 212–225. http://doi.org/10.1080/09575146.2013.771152

130. McFarland, A. L., Zajicek, J. M., & Waliczek, T. M. (2014). The relationship between parental attitudes toward nature and the amount of time children spend in outdoor recreation. *Journal of Leisure Research*, *46*(5), 525–539. Retrieved from http://search.proquest.com/docview/1646752711?accountid=13607\nhttp://e-tidsskrifter.kb.dk/resolve??url_ver=Z39.88-2004&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&genre=article&sid=ProQ:ProQ:socscijournals&atitle=The+Relationship+between+Parental+Attitudes
131. McMinn, D., Oreskovic, N. M., Aitkenhead, M. J., Johnston, D. W., Murtagh, S., & Rowe, D. A. (2014). The physical environment and health-enhancing activity during the school commute: Global positioning system, geographical information systems and accelerometry. *Geospatial Health*, *8*(2), 569–572. http://doi.org/10.4081/gh.2014.46
132. Meinen, A., Friese, B., Wright, W., & Carrel, A. (2012). Youth gardens increase healthy behaviors in young children. *Journal of Hunger & Environmental Nutrition*, *7*, 192–204. http://doi.org/10.1080/19320248.2012.704662
133. Melius, J. (2013). Overweight and obesity in minority children and implications for family and community social work. *Social Work in Public Health*, *28*, 119–128. http://doi.org/10.1080/19371918.2011.560821
134. Mitchell, C.A., Clark, A.F., & Gilliland, J. A. (2016). Built environment influences on children's physical activity: Examining differences by neighbourhood size and sex. *International Journal of Environmental Research and Public Health, 13* (1), 130. doi:10.3390/ijerph13010130.
135. Morgan, P. J., Warren, J. M., Lubans, D. R., Saunders, K. L., Quick, G. I., & Collins, C. E. (2010). The impact of nutrition education with and without a school garden on knowledge, vegetable intake and preferences and quality of school life among primary-school students. *Public Health Nutrition*, *13*(11), 1931–1940. http://doi.org/10.1017/S1368980010000959
136. Müderrisoglu, H., & Gultekin, P. G. (2015). Understanding the children's perception and preferences on nature-based outdoor landscape. *Indoor and Built Environment*, *24*(3), 340–354. http://doi.org/10.1177/1420326X13509393
137. Nicaise, V., Kahan, D., Reuben, K., Sallis, J. F., Sallis F., J., & Sallis, J. F. (2012). Evaluation of a redesigned outdoor space on preschool children's physical activity during recess. *Pediatric Exercise Science*, *24*, 507–518. Retrieved from 23196760\nhttps://login.proxy.bib.uottawa.ca/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=s3h&AN=83779458&site=ehost-live\nhttp://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=2011767281&site=ehost-live
138. Nichol, M., Janssen, I., & Pickett, W. (2010). Associations between neighborhood safety, availability of recreational facilities, and adolescent physical activity among Canadian youth. *Journal of Physical Activity & Health*, *7*, 442–450.
139. Norman, G. J., Adams, M. A., Kerr, J., Ryan, S., Frank, L. D., & Roesch, S. C. (2010). A latent profile analysis of neighborhood recreation environments in relation to adolescent physical activity, sedentary time, and obesity NIH public

access. *Journal of Public Health Management and Practice*, *16*(5), 411–419. http://doi.org/10.1097/PHH.0b013e3181c60e92
140. Norman, G. J., Nutter, S. K., Ryan, S., Sallis, J. F., Calfas, K. J., & Patrick, K. (2006). Community design and access to recreational facilities as correlates of adolescent physical activity and body-mass index. *Journal of Physical Activity & Health*, *3*, S118.
141. Norton, C. L., Wisner, B. L., Krugh, M., & Penn, A. (2014). Helping youth transition into an alternative residential school setting: Exploring the effects of a wilderness orientation program on youth purpose and identity complexity. *Child and Adolescent Social Work Journal*, *31*, 475–493. http://doi.org/10.1007/s10560-014-0331-y
142. O 'Brien, L., & Murray, R. (2007). Forest School and its impacts on young children: Case studies in Britain. *Urban Forestry & Urban Greening*, *6*, 249–265. http://doi.org/10.1016/j.ufug.2007.03.006
143. O'Brien, L. (2009). Learning outdoors: the forest school approach. *Education 3-13*, *37*(1), 45–60. http://doi.org/10.1080/03004270802291798
144. Ooko, S., Muthomi, H., & Odhiambo, G. (2015). Impact of outdoor adventure education on Kenyan youth, in peace building. *World Leisure Journal*, *57*(4), 297–305. http://doi.org/10.1080/16078055.2015.1081270
145. Opper, B., Maree, J. G., Fletcher, L., & Sommerville, J. (2014). Efficacy of outdoor adventure education in developing emotional intelligence during adolescence. *Journal of Psychology in Africa*, *24*(2), 193–196. http://doi.org/10.1080/14330237.2014.903076
146. Pagels, P., Raustorp, A., De Leon, A. P., Mårtensson, F., Kylin, M., & Boldemann, C. (2014). A repeated measurement study investigating the impact of school outdoor environment upon physical activity across ages and seasons in Swedish second, fifth and eighth graders. *BMC Public Health*, *14*(803), 1–9. http://doi.org/10.1186/1471-2458-14-803
147. Parmer, S. M., Salisbury-Glennon, J., Shannon, D., & Struempler, B. (2009). School gardens: an experiential learning approach for a nutrition education program to increase fruit and vegetable knowledge, preference, and consumption among second-grade students. *Journal of Nutrition Education and Behavior*, *41*(3), 212–217. http://doi.org/10.1016/j.jneb.2008.06.002
148. Pate, R.R., Colabianchi, N., Porter, D., Almeida, M.J., Lobelo, F., & Dowda, M. (2008). Physical activity and neighbourhood resources in high school girls. *American Journal of Preventive Medicine, 34* (5), 413-419.
149. Paudel, S., Subedi, N., Bhandari, R., Bastola, R., Niroula, R., & Kumar Poudyal, A. (2014). Estimation of leisure time physical activity and sedentary behaviour among school adolescents in Nepal. *BMC Public Health*, *14*, 1–10. http://doi.org/10.1186/1471-2458-14-637
150. Pawlowski, C., Andersen, H. B., Troelsen, J., Schipperijn, J., & Lucia, A. (2016). Children's physical activity behavior during school recess: A pilot study using GPS, accelerometer, participant observation, and go-along interview. *PLOS One*, *11*(2), 1–17. http://doi.org/10.1371/journal.pone.0148786
151. Petticrew, M. & Robert, H. (2008). Systematic Reviews in the Social sciences: A practical guide. Blackwell Publishing. United Kingdom

152. Perry, C. K., Saelens, B. E., & Thompson, B. (2011). Rural latino youth park use: Characteristics, park amenities, and physical activity. *Journal of Community Health*, *36*, 389–397. http://doi.org/10.1007/s10900-010-9320-z
153. Potestio, M. L., Patel, A. B., Powell, C. D., McNeil, D. A, Jacobson, R. D., & McLaren, L.(2009). Is there an association between spatial access to parks/green space and childhood overweight/obesity in Calgary, Canada? *International Journal of Behavioral Nutrition and Physical Activity*, *6*(77), 1–10. http://doi.org/10.1186/1479-5868-6-77
154. Potwarka, L. R., Kaczynski, A. T., & Flack, A. L. (2008). Places to play: Association of park space and facilities with healthy weight status among children. *Journal of Community Health*, *33*, 344–350. http://doi.org/10.1007/s10900-008-9104-x
155. Powell, E., Woodfield, L. a., & Nevill, a. a. (2016). Children's physical activity levels during primary school break times: A quantitative and qualitative research design. *European Physical Education Review*, *22*(1), 82–98. http://doi.org/10.1177/1356336X15591135
156. Prins, R. G., Oenema, A., van der Horst, K., & Brug, J. (2009). Objective and perceived availability of physical activity opportunities: Differences in associations with physical activity behavior among urban adolescents. *International Journal of Behavioural Nutrition and Physical Activity, 6* (1), 70.
157. Pryor, A., Townsend, M., Maller, C., & Field, K. (2006). Health and well-being naturally: "contact with nature" in health promotion for targerted individuals communities and populations. *Health Promotion Journal of Australia*, *17*(2), 114–123.
158. Quigg, R., Gray, A., Reeder, A. I., Holt, A., & Waters, D. L. (2010). Using accelerometers and GPS units to identify the proportion of daily physical activity located in parks with playgrounds in New Zealand children. *Preventive Medicineedicine*, *50*, 235–240. http://doi.org/10.1016/j.ypmed.2010.02.002
159. Reed, J.A., & Hooker, S.P. (2012). Where are youth physically active? A descriptive examination of 45 parks in southeastern community. *Childhood Obesity (Formerly Obesity and Weight Management), 8* (2), 124-131.
160. Reed, J. A., Price, A. E., Grost, L., & Mantinan, K. (2012). Demographic characteristics and physical activity behaviors in sixteen Michigan parks. *Journal of Community Health*, *37*, 507–512. http://doi.org/10.1007/s10900-011-9471-6
161. Reed, K., Wood, C., Barton, J., Pretty, J. N., Cohen, D., & Sandercock, G. R. H. (2013). A repeated measures experiment of green exercise to improve self-esteem in UK school children. *PLoS ONE*, *8*(7), e69176. http://doi.org/10.1371/journal.pone.0069176
162. Reis, R. S., Hino, A. A. F., Florindo, A. A., Añez, C. R. R., & Domingues, M. R. (2009). Association between physical activity in parks and perceived environment: A study with adolescents. *Journal of Physical Activity and Health*, *19*, 503–509. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-67650803475&partnerID=tZOtx3y1
163. Ries, A. V., Voorhees, C. C., Roche, K. M., Gittelsohn, J., Yan, A. F., & Astone, N. M. (2009). A quantitative examination of park characteristics related to park use and physical activity among urban youth. *Journal of Adolescent Health*, *45*,

S64–S70. http://doi.org/10.1016/j.jadohealth.2009.04.020
164. Ritchie, S. D., Wabano, M. J., Russell, K., Enosse, L., & Young, N. L. (2014). Promoting resilience and wellbeing through an outdoor intervention designed for Aboriginal adolescents. *Rural and Remote Health*, *14*, 2523. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-84907192187&partnerID=tZOtx3y1
165. Roe, J., & Aspinall, P. (2011). The restorative benefits of walking in urban and rural settings in adults with good and poor mental health. *Urban Forestry & Urban Greening*, *10*, 205–212. http://doi.org/10.1016/j.healthplace.2010.09.003
166. Roemmich, J. N., Beeler, J. E., & Johnson, L. (2014). A microenvironment approach to reducing sedentary time and increasing physical activity of children and adults at a playground. *Preventive Medicine*, *62*, 108–112. http://doi.org/10.1016/j.ypmed.2014.01.018
167. Roemmich, J. N., Epstein, L. H., Raja, S., Yin, L., Robinson, J., & Winiewicz, D. (2006). Association of access to parks and recreational facilities with the physical activity of young children. *Preventive medicine*, *43*(6), 437-441.
168. Roemmich, J. N., Epstein, L. H., Raja, S., Yin, L., Robinson, J., & Winiewicz, D. (2006). Association of access to parks and recreational facilities with the physical activity of young children. *Preventive Medicine*, *43*, 437–441. http://doi.org/10.1016/j.ypmed.2006.07.007
169. Romi, S., & Kohan, E. (2004). Wilderness programs: Principles, possibilities and opportunities for intervention with dropout adolescents. *Child & Youth Care Forum*, *33*(2), 115–136. http://doi.org/10.1023/B:CCAR.0000019634.47226.ab
170. Rosenberg, D., Ding, D., Sallis, J.F., Kerr, J., Norman, G.J., Durant, N., …& Saelens, B.E. (2009). Neighbourhood environment walkability scale for youth (NEWS-Y): reliability and relationships with physical activity. *Preventive Medicine, 49* (2), 213-218.
171. Ruiz-Gallardo, J.-R., Verde, A., & Valdés, A. (2013). Garden-based learning: An experience with "at risk" secondary education students. *The Journal of Environmental Education*, *44*(4), 252–270. http://doi.org/10.1080/00958964.2013.786669
172. Russell, K. (2003). An assessment of outcomes in outdoor behavioral healthcare treatment. *Child & Youth Care Forum*, *32*(6), 355–381. http://doi.org/10.1023/B:CCAR.0000004507.12946.7e
173. Sallis, J.F., Taylor, W.C., Dowda, M., Freedson, P.S., & Pate, R.R. (2002). Correlates of vigorous physical activity for children in grades 1 through 12: Comparing parent-reported and objectively measured physical activity. *Pediatric Exercise Science, 14* (1), 30.
174. Sanders, T., Feng, X., Fahey, P. P., Lonsdale, C., & Astell-Burt, T. (2015a). Green space and child weight status: Does outcome measurement matter? Evidence from an Australian longitudinal study. *Journal of Obesity*, *2015*, 1–8. http://doi.org/10.1155/2015/194838
175. Sanders, T., Feng, X., Fahey, P. P., Lonsdale, C., & Astell-Burt, T. (2015b). The influence of neighbourhood green space on children's physical activity and screen time: findings from the longitudinal study of Australian children. *International Journal of Behavioral Nutrition and Physical Activity*, *12*(126), 1–9.

http://doi.org/10.1186/s12966-015-0288-z
176. Sanders, T., Feng, X., Fahey, P. P., Lonsdale, C., & Astell-Burt, T. (2015c). Greener neighbourhoods, slimmer children? Evidence from 4423 participants aged 6 to 13 years in the longitudinal study of Australian children. *International Journal of Obesity*, *39*, 1224–1229. http://doi.org/10.1038/ijo.2015.69
177. Schell, L., Cotton, S., & Luxmoore, M. (2012). Outdoor adventure for young people with a mental illness. *Early Intervention in Psychiatry*, *6*, 407–414. http://doi.org/10.1111/j.1751-7893.2011.00326.x
178. Silva, P., Santos, R., Welk, G., & Mota, J. (2011). Seasonal differences in physical activity and sedentary patterns: The relevance of the PA context. *Journal of Sports Science and Medicine*, *10*, 66–72.
179. Singh, G. K., Siahpush, M., & Kogan, M. D. (2010). Neighborhood socioeconomic conditions, built environments, and childhood obesity. *Health Affairs*, *29*(3), 503–512.
180. Slaney, G., Salmon, J., & Weinstein, P. (2012). Can a school based programme in a natural environment reduce BMI in overweight adolescents? *Medical Hypotheses*, *79*, 68–70. http://doi.org/10.1016/j.mehy.2012.04.002
181. Spears-Lanoix, E. C., Lisako, E., Mckyer, J., Evans, A., Mcintosh, W. A., Ory, M., … Warren, J. L. (2015). Using family-focused garden, nutrition, and physical activity programs to reduce childhood obesity: The Texas! Go! Eat! Grow! Pilot Study. *Childhood Obesity*, *11*(6), 707–714. http://doi.org/10.1089/chi.2015.0032
182. Söderström, M., Boldemann, C., Sahlin, U., Mårtensson, F., Raustorp, A., & Blennow, M. (2013). The quality of the outdoor environment influences childrens health - A cross-sectional study of preschools. *Acta Paediatrica*, *102*, 83–91. http://doi.org/10.1111/apa.12047
183. Sugiyama, T., Okely, A. D., Masters, J. M., & Moore, G. T. (2010). Attributes of child care centers and outdoor play areas associated with preschoolers' physical activity and sedentary behavior. *Environment and Behavior*, *44*(3), 334–349. http://doi.org/10.1177/0013916510393276
184. Tappe, K. A., Glanz, K., Sallis, J. F., Zhou, C., & Saelens, B. E. (2013). Children's physical activity and parents' perception of the neighborhood environment: neighborhood impact on kids study. *The International Journal of Behavioral Nutrition and Physical Activity*, *10*(39), 1–10. http://doi.org/10.1186/1479-5868-10-39
185. Taylor, A. F., & Kuo, F. E. (2006). Is contact with nature important for healthy child development? State of the evidence. In C. Spencer, & M. Blades (Eds.), Children and their environments: Learning, using and designing spaces (pp. 124–139). Cambridge, UK: Cambridge University Press
186. Taylor, A. F., & Kuo, F. E. M. (2011). Could exposure to everyday green spaces help treat ADHD? evidence from children's play settings. *Applied Psychology: Health and Well-Being*, *3*(3), 281–303. http://doi.org/10.1111/j.1758-0854.2011.01052.x
187. Taylor, A. F., Kuo, F., & Sullivan, W. (2001). Coping with ADD. The surprising connection to green play settings. *Environment & Behavior*, *33*(1), 54–77.
188. Taylor, A. F., Wiley, A., Kuo, F. E., & Sullivan, W. C. (1998). Growing up in the inner city: Green spaces as places to grow. *Environment and Behavior*, *30*(1), 3–

27. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-0031799859&partnerID=tZOtx3y1
189. Timperio, A., Crawford, D., Telford, A., & Salmon, J. (2004). Perceptions about the local neighborhood and walking and cycling among children. *Preventive Medicine, 38*(1), 39-47.
190. Timperio, A., Giles-Corti, B., Crawford, D., Andrianopoulos, N., Ball, K., Salmon, J., & Hume, C. (2008). Features of public open spaces and physical activity among children: Findings from the CLAN study. *Preventive Medicine*, *47*, 514–518. http://doi.org/10.1016/j.ypmed.2008.07.015
191. The World Health Organization (2005). The World Health Report: Make every mother and child count.
192. Tremblay, M.S., & Willms, J. D. (2000). Secular trends in body mass index of Canadian children. *Canadian Medical Association Journal, 163* (11), 1429-1433.
193. Tucker, P., Irwin, J. D., Gilliland, J., He, M., Larsen, K., & Hess, P. (2009). Environmental influences on physical activity levels in youth. *Health & Place, 15* 1), 357-363.
194. Utter, J., Denny, S., & Dyson, B. (2016). School gardens and adolescent nutrition and BMI: Results from a national, multilevel study. *Preventive Medicine*, *83*, 1–4. http://doi.org/10.1016/j.ypmed.2015.11.022
195. Utter, J., Denny, S., Robinson, E. M., Ameratunga, S., & Watson, P. (2006). Perceived access to community facilities, social motivation, and physical activity among New Zealand youth. *Journal of Adolescent Health*, *39*(5), 770-773.
196. van den Berg, A. E., & van den Berg, C. G. (2011). A comparison of children with ADHD in a natural and built setting. *Child: Care, Health and Development*, *37*(3), 430–439. http://doi.org/10.1111/j.1365-2214.2010.01172.x
197. Veitch, J., Timperio, A., Crawford, D., Abbott, G., Giles-Corti, B., & Salmon, J. (2011). Is the neighbourhood environment associated with sedentary behaviour outside of school hours among children? *Annals of Behavioral Medicine*, *41*, 333–341. http://doi.org/10.1007/s12160-011-9260-6
198. Veitch, J., Ball, K., Crawford, D., Abbott, G. R., & Salmon, J. (2012). Park improvements and park activity: a natural experiment. *American Journal of Preventive Medicine*, *42*(6), 616–619. http://doi.org/10.1016/j.amepre.2012.02.015
199. Veugelers, P., Sithole, F., Zhange, S., & Muhajarine, N. (2008). Neighbourhood characteristics in relation to diet, physical activity and overweight of Canadian children. *International Journal of Pediatric Obesity, 3*(3), 152-159.
200. Waliczek, T. M., Bradley, J. C., & Zajicek, J. M. (2001). The effect of school gardens on children's interpersonal relationships and attitudes toward school. *HortTechnology*, *11*(3), 466–468. Retrieved from http://www.scopus.com/inward/record.url?eid=2-s2.0-0034962299&partnerID=tZOtx3y1
201. Wall, M. M., Larson, N. I., Forsyth, A., Van, D. C., Graham, D. J., Story, M. T., & Neumark-, D. R. (2012). Patterns of obesogenic neighborhood features and adolescent weight : A comparison of statistical approaches. *American Journal of Preventive Medicine*, *42*(5), 1–19.

http://doi.org/10.1016/j.amepre.2012.02.009.Patterns
202. Wadell, C., McEwan, K., Peters, R. D., Hua, J. M., & Garland, O. (2007). Preventing mental disorders in children: A public health priority. *Canadian Journal of Public Health, 98* (3), 174-178.
203. Wasserman, J. a, Suminski, R., Xi, J., Mayfield, C., Glaros, a, & Magie, R. (2014). A multi-level analysis showing associations between school neighborhood and child body mass index. *International Journal of Obesity*, *38*, 912–918. http://doi.org/10.1038/ijo.2014.64
204. Wells, N. (2000). At home with nature: Effects of " Greenness " on children's cognitive functioning. *Environment & Behavior*, *32*(6), 775–795.
205. Wells, N. M., & Evans, G. W. (2003). Nearby nature: A buffer of life stress among rural children. *Environment & Behavior*, *35*(3), 311–330.
206. Wells, N. M., Myers, B. M., & Henderson, C. R. (2014). School gardens and physical activity: A randomized controlled trial of low-income elementary schools. *Preventive Medicine*, *69*, 27–33. http://doi.org/10.1016/j.ypmed.2014.10.012
207. Wheeler, B. W., Cooper, A. R., Page, A. S., & Jago, R. (2010). Green space and children's physical activity: A GPS/GIS analysis of the PEACH project. *Preventive Medicine*, *51*, 148–52. http://doi.org/10.1016/j.ypmed.2010.06.001
208. White, R. (2012). A sociocultural investigation of the efficacy of outdoor education to improve learner engagement. *Emotional and Behavioural Difficulties*, *17*(1), 13–23. http://doi.org/10.1080/13632752.2012.652422
209. Whittington, A., Aspelmeier, J. E., & Budbill, N. W. (2016). Promoting resiliency in adolescent girls through adventure programming. *Journal of Adventure Education and Outdoor Learning*, *16*(1), 2–15. http://doi.org/10.1080/14729679.2015.1047872
210. Wilhelm Stanis, S. A., Oftedal, A., & Schneider, I. (2014). Association of outdoor recreation availability with physical activity and weight status in Minnesota youth. *Preventive Medicine*, *60*, 124–127. http://doi.org/10.1016/j.ypmed.2013.11.010
211. Wolch, J., Jerrett, M., Reynolds, K., McConnell, R., Chang, R., Dahmann, N., … Berhane, K. (2011). Childhood obesity and proximity to urban parks and recreational resources: a longitudinal cohort study. *Health & Place*, *17*(1), 207–214. http://doi.org/10.1016/j.healthplace.2010.10.001
212. Wood, C., Gladwell, V., & Barton, J. (2014). A repeated measures experiment of school playing environment to increase physical activity and enhance self-esteem in UK school children. *PLOS One*, *9*(9), 1–5. http://doi.org/10.1371/journal.pone.0108701
213. Wu, C. Da, McNeely, E., Cedeño-Laurent, J. G., Pan, W. C., Adamkiewicz, G., Dominici, F., … Spengler, J. D. (2014). Linking student performance in Massachusetts elementary schools with the "greenness" of school surroundings using remote sensing. *PLoS ONE*, *9*(10), e108548. http://doi.org/10.1371/journal.pone.0108548